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New Zealand Geographer

VOLUME VII

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SEACLIFFS OF BANKS PENINSULA AND WELLINGTON : SOME CRITERIA FOR COASTAL CLASSIFICATION*

C. A. COTTON

THE HIGH SEACLIFFS of Banks Peninsula and of Wellington have very different histories. The latter furnish an example of marine erosion working at a fast tempo in the current cycle, the former of such erosion at almost its slowest. The coasts are in contrast also in that for Wellington very recent differential movements of the land must be assumed to account for the assemblage of coastal features, while those of Banks Peninsula call for recognition only of a general change in relative levels of sea and land, and this is attributable for the most part to movements of ocean level.

Comparison of the developmental histories of cliffs in these two cases brings out some principles which may prove of value when a renewed attack is made on the problem of coastal classification.

The classification of coasts and shorelines is in the melting-pot. Structure of the hinterland as the chief criterion of classification has been tried, as in the separation by Suess of 'Atlantic' and 'Pacific' coasts, but without successfully establishing distinctive types of 'coast-escape'. As main categories, coasts of submergence and emergence are equally in discredit with some systematists, chiefly owing to a conviction that the majority of coasts must be compound, exhibiting features attributable to both submergence and emergence because of the oscillation of ocean level.

An alternative dichotomous classification might begin by making a distinction between the coasts of stable regions, which are affected only by oscillation of ocean level, and those of the mobile belts, in which the outlines of the land have been changed by the occurrence of very recent earth movements; but no concrete suggestions appear to have been made for classification on this basis. The question might be raised

*This paper on the coasts of Banks Peninsula and Wellington has been divided into two parts. The second section will be published in the next number of the *New Zealand Geographer*.

whether such a dichotomy would not be very lopsided; for Baulig has claimed that 'shifts of sea level' are eustatic 'except for *very limited* and distinctly unstable regions'.¹ When more becomes known of regional geomorphology, especially of the great seismic regions, however, it may be found that the balance is more even.

Among the factors controlling the infinite variety of coastal landscape forms three might be selected for study as especially important from the point of view of possible use in schemes of classification: first, the tempo of marine erosion; secondly, the effects of recent tectonics, or diastrophism; and thirdly, accidents and interruptions in the course of the cycle of marine erosion. In this article it is proposed to examine some of the results of varying erosion tempo and some of the effects of local diastrophism. Accidents and interruptions have been treated elsewhere.²

OSCILLATION OF OCEAN LEVEL

It is impossible to picture the evolution of coasts or even to begin the explanation of coastal outlines or profiles in any part of the world without taking into account the instability and wide oscillations of the level of the ocean surface in the last few hundred thousand years caused by variation in the size of glaciers all over the earth. The reason why coasts of submergence are dominant throughout the world must be attributed to the late-glacial fluctuation of ocean level and its eventual rise in postglacial time as the Flandrian transgression. The key to an understanding of many coasts seems, moreover, to be the recognition of a large amount of subaerial erosion in the glacial ages, at times when sufficient ocean water had been withdrawn (for the making of continental ice sheets and the extension of mountain glaciers) to lower the level of the ocean eustatically for some hundreds of feet.³ As a result of such temporary lowering of their base levels the lower valleys of all large rivers were rejuvenated in the ice ages, and in weak-rock terrains most of them were greatly enlarged also, even in the last glacial age.

Offshore from some coasts at least the profile of the shelf must also

¹ H. Baulig: 'The Changing Sea Level', *Pub. Inst. British Geogr.* No. 3, 1935, p. 46.

² In an article in the *Geographical Journal*.

³ R. A. Daly: 'Pleistocene Changes of Level', *Amer. Journ. Sci.*, Vol. 10, 1925, pp. 281-313. See also *The Changing World of the Ice Age*, New Haven, 1934; Ernst Antevs: *The Last Glaciation*, New York, 1928, pp. 81-82; R. F. Flint: *Glacial Geology and the Pleistocene Epoch*, New York, 1947, pp. 434-435; but compare F. P. Shepard: *Submarine Geology*, New York, 1948, pp. 244-245.

have been lowered considerably by marine erosion at that time, though it has been to a great extent built up again by sedimentation during and since the postglacial return of the sea. This is a speculative matter, however.⁴

The postglacial rise of ocean level may be thought of as beginning with the first stages of wasting of the 'last' (or Würm) continental ice sheets, but it continued, though with very considerable oscillation, throughout a long period during which ice sheets advanced and retreated. Three phases of the 'last' glacial period are sometimes referred to conveniently as W₁, W₂, and W₃. Interstadial intervals between these, W₁-W₂ and W₂-W₃, are believed to have been mild enough to melt much ice, causing the ocean level to rise considerably, but it may not then have ever risen to its present level. Much evidence from 'raised beaches' in various stable regions is interpreted, however, to mean that in the latter part of the pre-Würm interglacial age the level of the sea was for a time higher by about thirty feet than it is now.

COASTAL BENCHES IN OTAGO

A narrow bench, or vestigial coastal plain, at a fairly constant level—so far as observations show—such as is seen at many places along the coast of North Otago and again at Brighton and other places southwest of the Otago Peninsula, is perhaps a relic of the pre-Würm shoreline. Higher benches near the mouth of the Clutha River may possibly date from more remote interglacial ages, in which the sea margin left traces at such levels in other parts of the world. This part of the South Island is now nonseismic, as Gutenberg and Richter have shown in a recent world survey of seismicity.⁵ Though subject somewhat earlier to strong deformation, it was perhaps relatively free from differential movement during the Pleistocene epoch of ice ages in which oscillation of ocean level was in progress.

Another part of New Zealand which is nonseismic and apparently quite stable is the North Auckland Peninsula, and in that district there may be a decipherable record of former high eustatic ocean levels in the broad belt of lightly consolidated young sandstone formations

⁴ P. H. Kuenen: 'The Formation of the Continental Terrace', *The Advancement of Science*, Vol. 7, 1950, pp. 76-80. This author's remark (p. 76): 'It has not been ascertained how profound have been the alterations it [the shelf] underwent and how far present superficial deposits represent fossil conditions or the action of sedimentation now in progress' is typical of the cautious attitude of the best authorities towards this question.

⁵ B. Gutenberg and C. F. Richter: *Seismicity of the Earth*, Princeton, 1949, p. 46, Fig. 14.

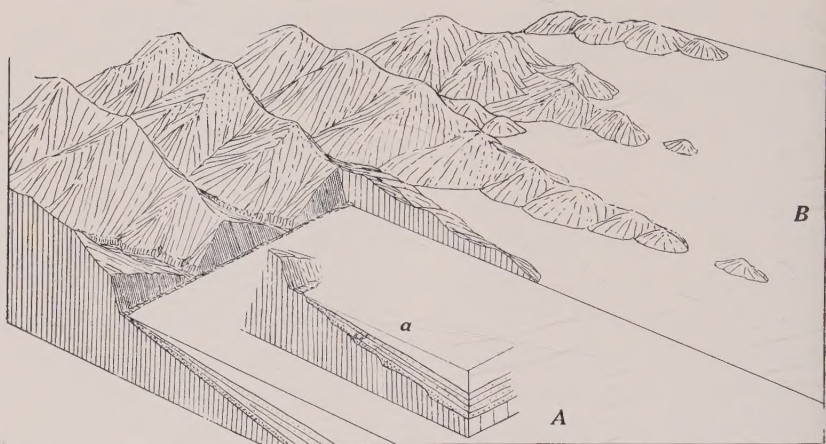


Fig. 1. Contrasting Cases of Coastal Submergence.

A: Submergence has been very gradual and has been accompanied by retrogradational cliffing of the coast. A submarine plain of marine erosion is cut and is progressively buried under shallow-sea sediments. (Inset *a*: Stepped profile produced in *A* if the submergence has been intermittent.)
B: Submergence has been very rapid, or the terrain is so resistant that contemporary erosion is negligible.

fringing the bedrock axis of the land along the west coast. These await geological investigation.

DATE AND AMPLITUDE OF THE FLANDRIAN TRANSGRESSION

Estimates of the duration of postglacial time based on the counting of varves in Sweden and Finland date the melting of the great ice sheets of the northern hemisphere so late as to make it impossible to allow more than 9000 years since the returning ocean began to approach its present level; and data furnished by pollen analysis of peats associated with beaches seem to indicate that the slowly rising water surface did not reach approximately present sea level until 4000 years ago.⁶ It is estimated, however, that there has been oscillation of level with a general upward tendency since, about 100,000 years ago, the ocean began to return after the W1 glacial phase, though its level must have dropped back in later glacial phases, once to about minus 200 feet and again later to about minus 100 feet. After the end of the W3 glacial phase the level of the ocean probably rose fairly steadily. It is only this last advance, beginning 20,000 years ago or thereabouts, that Zeuner now terms Flandrian.

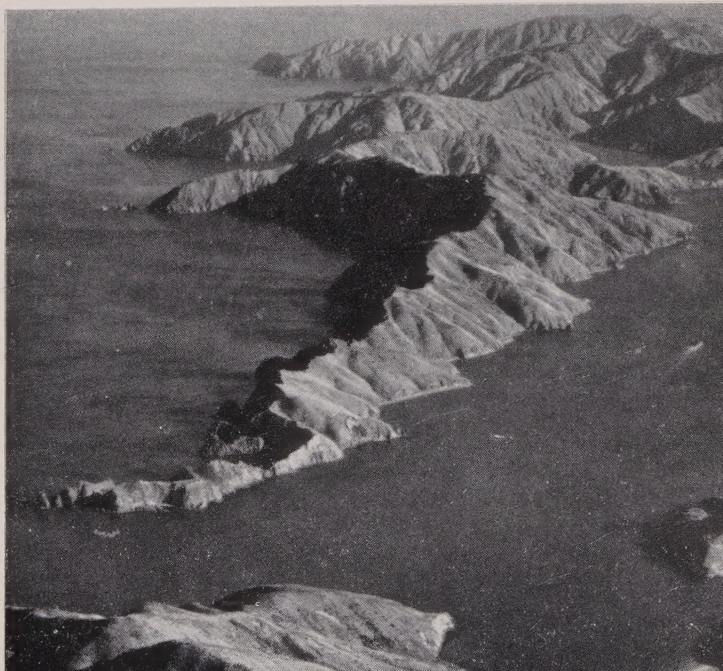
⁶ F. E. Zeuner: *Dating the Past*, second edition, London, 1950, p. 51, Fig. 17, and p. 101.

During the course of the whole fluctuating transgression—spread over perhaps 100,000 years—which began in the interstadial W₁-W₂ profiles of the coast must have changed very considerably, especially in a belt lying offshore from the coasts of the present day, for a rising sea level provided theoretically favourable conditions for marine erosion⁷ (Fig. 1, A). Thus shoreline erosion which took place nearly 100,000 years ago in a belt seaward of the present coast has no doubt greatly facilitated the attack of waves on many parts of the 'initial' shoreline of the current cycle as it was eventually outlined by the sea margin when, very recently, the ocean surface had ceased to rise (Fig. 1, B).

The freshness of some drowned coastal outlines so determined, especially in situations sheltered from direct attack of ocean waves (Fig. 2), can be understood if the sea has lapped against the slopes of the land at approximately its present level for only a few thousand years. In many places, however, the development of cliffs even in this comparatively short interval has been spectacular; and the cumulative effects of erosion in an offshore belt over a period ten or twenty times as long throughout earlier and the Flandrian transgressions have to be taken into account in any elaboration of explanatory coastal hypotheses. This is a belt not only hidden from sight now as a result of progressive submergence but also buried under, or at least veneered with, the deposits of the transgressional cycle of sedimentation (Fig. 1, A).

⁷ Changes in the offshore profile during progressive submergence have been deduced by W. M. Davis. See *The Coral Reef Problem*, New York, 1928, pp. 128-130, Figs. 48-50.

Fig. 2. Tory Channel, Marlborough Sounds. There has been only slight modification of the drowned coastal outline by marine erosion within landlocked embayments, while an external coast facing Cook Strait is more strongly cliffed. The channel entrance is a submerged divide.



Various estimates of the extent of withdrawal of the sea in the last glacial age and, therefore, of the rise of ocean level attributable to its return, which have been made on the basis of probable areas and thicknesses of Pleistocene ice masses, place it in the vicinity of 300 feet.

It need not be discussed whether there is reliable evidence from submarine canyons to indicate an enormously greater oscillation, as very few such sea-floor features seem to be related to forms of the coast. Only rare examples of trenches cut into the continental shelf testify to erosion by rivers which extended across it during the last glacial epoch even to a shoreline 300 feet lower than the present one; but, as Baulig points out, this is mainly because of a more recent smoothing of the sea floor by erosion and by sedimentation on the shelf. This smoothing has destroyed or masked most of such river-cut channels.⁸

CHANGING LEVELS IN THE ADRIATIC

In the sheltered waters of the Adriatic, however, at its northern end and occupying about a third of the area of that sea, there is a submarine plain which was apparently formed as a large subaerial delta of the River Po in one of the later glacial ages. If this is so, it indicates a sea level 300 to 400 feet lower at that time than at present. The submerged plain is traversed by a branching system of valleys, now shallow furrows on the sea floor, and cut apparently by rivers which at some time trenched the surface, though to no great depth, and were last graded during the period of maximum emergence (W1) in the last glacial advance. This suggests that the level of the sea was then 300 feet lower than now.⁹

To cite another example, the trunk stream of a very extensive branching system of shallow valleys on the floor of the Sunda Sea, west of Borneo, seems to have discharged northward to a sea level 300 feet lower than that of today.¹⁰

The recent rise of ocean level is shown also by the thickness of deposits which have accumulated marginally at places where, sediment

⁸ Baulig remarks: 'The tendency of wave action . . . is to level out inequalities of the bottom by erosion and deposition. Such action actively in operation while following the migration of the shoreline throughout the Flandrian transgression cannot but have filled submerged river channels.' (Free translation from Henri Baulig: 'Problèmes des terrasses: éclaircissements et répliques', *VI Rap. Comm. Etude Terrasses, Union Géog. Internat.*, Paris, 1948, p. 11.) See also H. Baulig: *Essais de Géomorphologie*, Paris, 1950, p. 62.

⁹ Luigi De Marchi: 'Variazioni del livello dell'Adriatico in corrispondenza colle espansioni glaciali,' *Atti Accad. Sci. Veneto-Trentino-Istriana*, Vol. 12-13, 1922, pp. 3-15.

¹⁰ P. H. Kuenen: *Marine Geology*, New York, 1950, p. 536 and Fig. 203.

being abundant, the shore has been built up, and usually forward also, during and notwithstanding progressive submergence. At places on the Tyrrhenian coast of Italy these are 300 feet thick.¹¹ In New Zealand, the Canterbury coast has been thus prograded, but on a scale so large that the weight of accumulating sediments has probably been great enough to depress the floor beneath them, allowing them to become thicker. Measurement of the minimum thickness of these sediments has been made by well-drilling at Christchurch, where they extend down to a depth of at least 600 feet, and, a few miles further north, to at least 450 feet.¹² It is probable that these thicknesses are greater than the amplitude of sea-level oscillation in the ice ages, however; for down-bowing of the coastal belt has probably taken place not only under the weight of the Canterbury river deltas growing both before and during the Flandrian transgression, but also, near Christchurch, under the heavy mass of volcanic rocks forming Banks Peninsula.

FAST-TEMPO EROSION

Pairs of photographs of hard-rock parts of the coast of California taken some fifty years apart have been reproduced to show that changes in the form of the cliffs and shoreline during such an interval are inappreciable, and Guilcher has remarked on the almost unchanged condition of some exposed parts of the coast of Brittany since the end of the Flandrian transgression. He has described the rate of retreat of cliffs in the hard rocks of that area as 'perhaps a thousand times slower' than the often cited rapid retrogradation of the softer chalk cliffs of Dover and northern France.¹³

It is not necessary, however, to turn to terrains of soft or incoherent rock to find cliffs undergoing rapid change. The high southward-facing cliffs of the Wellington Peninsula, for example, though they consist of relatively resistant greywacke formations, are visibly crumbling (*Fig. 3*). Seacliffs everywhere, with the exception of those which for one reason or another stand with nearly vertical faces, are continu-

¹¹ A. C. Blanc: 'Low Levels of the Mediterranean Sea during the Pleistocene Glaciation', *Quart. Journ. Geol. Soc.*, Vol. 93, 1937, pp. 621-651.

¹² R. Speight: 'A Preliminary Account of the Geological Features of the Christchurch Artesian Area', *Trans. & Proc. N.Z. Institute*, Vol. 43, 1911, p. 426; B. W. Collins: 'Ground Water in North Canterbury between the Waimakariri and Ashley Rivers', *N.Z. Journ. Sci. & Tech.*, Vol. 30, 1950, p. 252.

¹³ F. P. Shepard and U. S. Grant: 'Wave Erosion along the Southern California Coast', *Bull. Geol. Soc. Amer.*, Vol. 58, 1947, pp. 919-926; and A. Guilcher: 'Quelques points de morphologie littorale', *L'Information Géographique*, No. 3, 1949, pp. 1-8.

ally subject to gullying by subaerial erosion, but normally the sea is actively removing the debris so produced as well as steepening the cliffs at the base by undercutting. In front of these Wellington cliffs, however, voluminous talus slopes and alluvial cones have been accumulating for ninety-six years, since such removal ceased (temporarily, no doubt) with a withdrawal of the sea caused by the local upheaval of 1855 which here exposed a fringing platform. Measurement of the volume of material in the confluent cones resting on this foreshore would allow a minimum estimate to be made of normal wastage and recession of such cliffs under wave attack. The tempo of erosion is certainly very fast.

MARINE EROSION AND TECTONIC SALIENTS

Across a terrain of heterogeneous rocks the marine erosional process does not always develop a straight line of cliffs; on the contrary, as a result of adjustment to structure, the outline of the shore when it has reached maturity is commonly sinuous and follows the pattern of the terrain (*Fig. 3*). On the other hand, salients, re-entrants or jogs not in this way related to the structure are short-lived on a coast that is subject to vigorous and rapid erosion. Non-structural jogs, if any survive, must be of recent tectonic origin, and these, like tectonic scarps in a landscape, are liable to be rapidly eliminated by erosion.

A tectonic shoreline jog has been destroyed, or prevented, at the southwestern end of the Wellington fault, where it runs out to sea

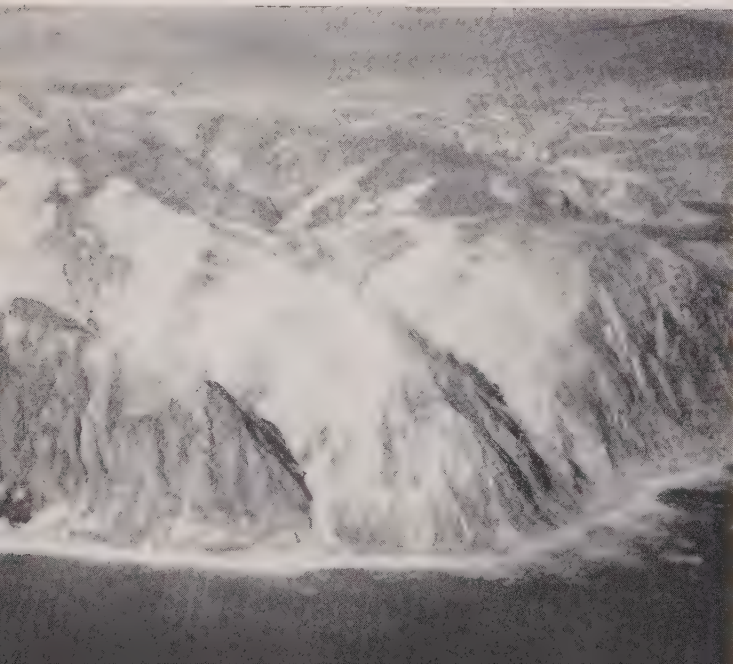


Fig. 3. High South-facing Cliffs near Sinclair Head, Wellington. They are bordered by a fringe of talus and alluvial cones resting on a raised beach.

on the south coast¹⁴ (Fig. 4). There is evidence of recent active transcurrent movement of about 200 feet on the fault, as shown by features of the landscape. Scarcely a trace of a salient or jog such as this would make remains, however, where the fault outcrops on the coastal cliff. It is reasonable, indeed, to infer that at this point particularly vigorous erosion has prevented the development in the high-cliffed coastline of a relatively large jog which would otherwise have been produced by a more extensive inferred movement of earlier date than that still traceable in the shutter-ridge pattern of the upland landscape. The potential form of this salient is indicated in plan in Figure 4.

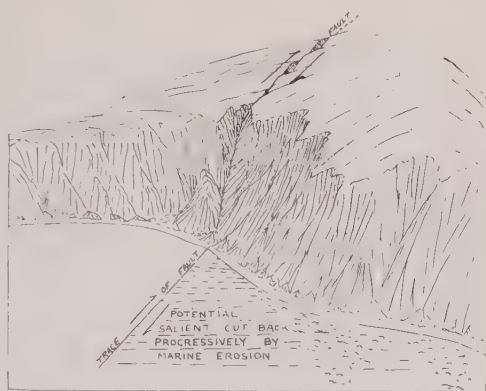


Fig. 4. Southwestern End of the Trace of the Wellington Fault.

PLUNGING CLIFFS

The coastal margins of soft-rock terrains 'flow from form to form' so rapidly that in their development the time factor is obviously of little consequence. After reviewing examples like those described above, moreover, it is safe to say that the rate of cliff-cutting even on harder rocks, though relatively slow, varies from stagnation to a rapidity capable of producing changes startlingly kaleidoscopic when viewed in the perspective of postglacial geological time. Coastal variety depends on such differences of tempo more than anything else; elapsed time is less important than other factors in determining the erosional development. The same is true, indeed, of land surfaces as well as coasts; and one recalls Davis's comparison of rates of development of an oak and a mushroom. An old mushroom, already senile and decaying—the analogue of a landscape reduced to insignificant relief by normal erosion on a terrain of soft, unconsolidated strata—has been in existence but a small fraction of the time required for

¹⁴ C. A. Cotton: 'Tectonic Scarps and Fault Valleys', *Bull. Geol. Soc. Amer.*, Vol. 61, 1950, pp. 717-756; *idem*: 'Fault Valleys and Shutter Ridges at Wellington', *N.Z. Geographer*, Vol. 7, 1951, pp. 62-68.

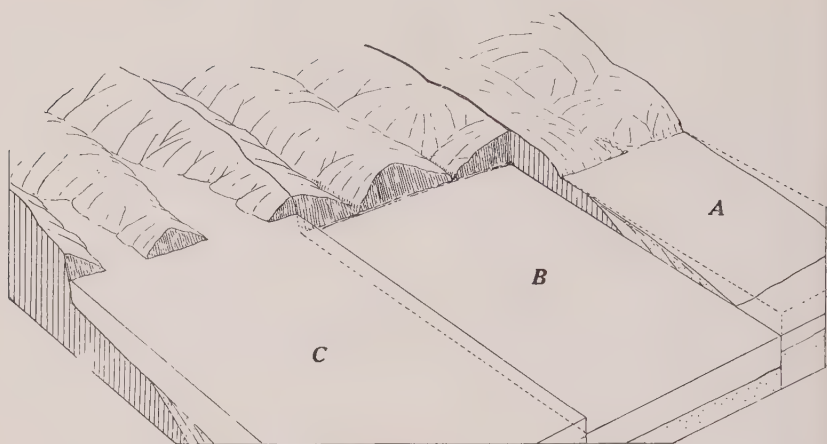


Fig. 5. Plunging Cliffs. (Broken lines in A indicate preglacial sea level.)

A: Withdrawal of the sea in a glacial age exposes a narrow coastal plain with a steep seaward slope underlain by weak, unconsolidated sediments.

B: Erosion in the glacial age cuts away the coastal plain and cliffs the hinterland.

C: The postglacial return of the sea embays the margin of the land and drowns the cliffs, which 'plunge' initially for 300 feet approximately.

the growth of a young oak, even for the germination of an acorn—analogue of very young gorge-cutting in hard crystalline rocks. Some coasts retain their form—perhaps a drowned outline—almost unchanged;¹⁵ but others, though the time that has elapsed since their initiation is no longer, have suffered profound changes of profile and even of outline.

Prior to the return of the sea in the Flandrian transgression it is probable that some coasts were cliffed in hard rocks. The cliffs were cut back in the preceding glacial age across the then ubiquitous coastal plain into its hinterland by exceptionally efficient wave work. Perhaps, in such situations, the former sea floor, exposed as a coastal plain when the ocean withdrew, sloped steeply and was underlain by the unconsolidated material of a built shelf (Fig. 5, A). If other conditions also favoured rapid marine erosion (some are referred to later under the heading of coastal cliffing), the narrow sloping coastal plain might be cut away entirely while the sea was at a low level and be replaced by a mature line of cliffs (Fig. 5, B). Return of the sea later would drown these cliffs at the base, producing either a continuous line of

¹⁵ The limestone coast of Dalmatia, for example, drowned by the postglacial return of the sea, has suffered but little since from the attack of marine erosion, even where exposed to the full force of waves of the Adriatic Sea; cliffs and complementary cut platforms are of insignificant dimensions. (Henri Baulig: 'Le littoral dalmate', *Annales de Géogr.*, Vol. 39, 1930, pp. 305-310.)

'plunging' cliffs in the postglacial marine cycle or headlands terminated by plunging cliffs and separated by bays or estuaries (*Fig. 5, C*).

It is quite possible that such plunging cliffs, the result of the Flandrian transgression, were not uncommon at the initiation of the postglacial shoreline cycle. These would for the most part border mountainous coasts of resistant rocks, for on such coasts the offshore gradient of the sea floor would commonly be steep enough to facilitate rapid erosion in the glacial age. Few plunging cliffs survive, however, unmodified by later erosion. Nearshore depths of forty to fifty fathoms, indicating infantile drowning of the bases of pre-existing cliffs, are extremely rare; but it is worth noting that along the southeastern shore of Banks Peninsula (*Fig. 8*), which is strongly swept by a northward-flowing ocean current that prevents accumulation of fine sediment, cliffs diagnosed as plunging have water twenty to thirty fathoms deep close to their bases.

Such inshore depths would be commoner were it not for heavy Flandrian sedimentation on the modern shelf. If, as must have been the case in some places, the shelf was cut down drastically by marine erosion in the last glacial age (*Fig. 6, A*), it has been built up again by sedimentation and largely regraded in accordance with the present higher stand of ocean level (*Fig. 6, B*). Infilling of the sea must have

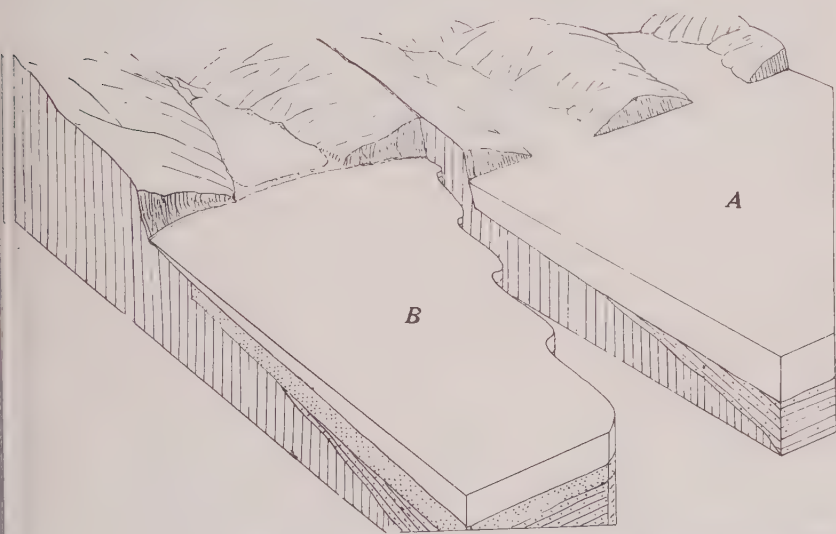


Fig. 6. Flandrian Sedimentation and Postglacial Coastal Development from Plunging Cliffs.
A: Potential initial form developed as in *Fig. 5, C*.
B: Coastal retrogradation, developing to a submature outline, is accompanied by offshore sedimentation.

gone on progressively off many coasts as the level gradually rose in Flandrian time. A considerable, though highly variable, proportion of the sediment for such infilling is commonly supplied by marine coastal erosion (such as is shown in *Fig. 6, B*); some also is brought to the sea locally by small streams; and the rest is transported alongshore from more distant sources by wave and current action. The bulk of such material may be greatly in excess of the supply from sources near at hand.

In general, cliffs initially plunging plunge no longer, but have now receded, leaving a cut platform at the base (*Fig. 6, B*). The coastal outline has meanwhile developed, perhaps to submaturity. In easily eroded terrains, indeed, if other conditions also have been favourable, the waves may have gnawed back coastal cliffs almost to or even beyond the heads of the initial embayments, making the outline of the land fully mature, as in the classic example of the rapidly retreating chalk cliffs which border the Strait of Dover. A continuous line of high cliffs so developed borders a Tertiary sandstone terrain of moderate to low resistance along the eastern half of the head of Palliser Bay, which is pounded hard by heavy seas driven in by southerly gales.

SURVIVAL OF PLUNGING CLIFFS

If, as postulated above, some such cliffs began their history in the current shoreline cycle as plunging cliffs, either rapid subaerial wasting and slumping of coarse debris from the cliffs themselves or a supply of sediment, coarse or fine, brought by alongshore transportation quickly shallowed the sea in front of them to an extent sufficient to facilitate marine erosion; from then on their retreat could proceed rapidly and perhaps uninterruptedly. Such being obviously the usual course of events, it is clear that the persistence or survival of plunging cliffs in the shoreline of today implies special conditions leading to postponement of the development of features referable to the current cycle. It is necessary to postulate not only vigorous coastal development and cliff recession in the penultimate cycle, that of low ocean level referable to the glacial age, but also a virtual moratorium of the same processes since the return of the sea to its present level.

It is possible, however, to picture conditions that would lead to such a result. Let it be assumed that the submerged part of the cliff is nearly vertical, or is at least too steep to allow waves to break vigorously, thus retaining a primitive steepness unimpaired by slumping or

the accumulation of a glaucous material of any kind. From such cliffs, if they descend very steeply to a considerable depth below sea level, ocean waves will be reflected instead of breaking (*Fig. 7*); and there is, moreover, no resting-place below them for the accumulation in shallow water of the rock fragments required for use as ammunition by waves attacking the bases of cliffs. Such small supply of debris as actually becomes detached and falls from the cliffs, or is pried loose



Photo: V. C. Broune

Fig. 7. Plunging Cliffs at Akaroa North Head, Banks Peninsula.

Reflection of an ocean swell is discernible.

by hydrostatic pressure when surging waves enter rock clefts, sinks into deep water, to remain there undisturbed.

An approximation to these conditions is found around the shores of some islands which began their existence as lava-built domes, or shield volcanoes, generally basaltic, but have since suffered erosion. Flanking these, Davis has described plunging cliffs which seem to have remained almost unaffected by marine erosion throughout post-glacial time.¹⁶ Excluding those of Tahiti and others in the tropical seas, where marine processes are complicated and erosion is delayed or prevented by growth of coral and the protection thereby afforded

¹⁶ W. M. Davis: *op. cit.*, pp. 151-154, 254.

to the land, the best known plunging cliffs are those of Banks Peninsula (Figs. 7, 8 and 11), a former island which is, like Tahiti, a volcanic-dome doublet.¹⁷

BANKS PENINSULA

The valleys of the large dissected basaltic mass of Banks Peninsula are extensively drowned, and unless the partial submergence thus indicated is attributable to a more recent isostatic sinking it must date from the return of the sea in the Flandrian transgression. Allowance of time required for sedimentation in the surrounding sea, which, except where swept by the current earlier referred to, has now been infilled with the formation of a graded shelf of considerable width, makes the hypothesis of more recent subsidence improbable. Here, then, is a case of postglacial shoreline evolution *at its slowest*. The stage of development shows but little change from the initial form, and may be described as infantile. Davis remarks: 'Although some steepening of the visible faces of the cliffs has presumably been produced by . . . wave work at present sea level, . . . cliff-cutting was chiefly accomplished during a much longer period of greater emergence, while the now-embayed valleys were in process of erosion.' During such emergence the margins of the broad domes were cut back to almost vertical cliffs, which must have been for the most part about 600 feet high. The gently-inclined lava sheets were truncated, and at their exposed edges erosion of almost any kind could make steep escarpments such as these.

Probably the main period of volcanic activity—that in which the building of the domes was completed—is no more ancient than Pleistocene. Thus no preglacial history of the coastal form need be postulated. During successive ice ages, however, the island, as it was then, must be thought of as subject to the effects of oscillations in ocean level. Erosion has gone on continuously, though base level has been moving down and up, throughout at least the middle and late Pleistocene. Time after time probably, in interglacial intervals as well as in the postglacial age, the sea has entered and, to some extent, drowned the valleys. A hypothesis of continuous slow sinking of the whole volcanic mass under its own weight, carrying down with it the

¹⁷ W. M. Davis: *op. cit.*, pp. 151-153; C. A. Cotton: 'Some Volcanic Landforms in New Zealand', *Journ. Geomorph.*, Vol. 4, 1941, pp. 303-305; *idem*: *Volcanoes as Landscape Forms*, Christchurch, 1944, pp. 392-398; *idem*: 'Plunging Cliffs, Lyttelton Harbour', *N.Z. Geographer*, Vol. 5, 1949, pp. 130-136.

surrounding sea floor and any adjacent land, must be called on to explain absence of marine benching and of river terraces accordant with interglacial levels of the ocean surface (if these were higher than its present level, as seems to have been the case, according to eustatic theory). Such sinking might become slower in its later stages, and has perhaps now almost or quite ceased. Its continuance would probably generate earthquakes; but only a few minor shocks are recorded as originating near the peninsula.

The volcanic and subsequent history of Banks Peninsula is rather closely paralleled by that of Campbell Island, far to the south of New Zealand, as described by Oliver,¹⁸ except that the western coast of that island has been, as might be expected from its Southern Ocean exposure, cliffed far back to a mature outline in a marine cycle that has since been interrupted by submergence. Cliffs of varying

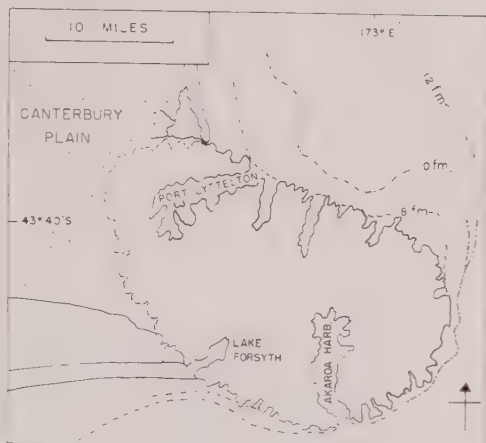


Fig. 8. Banks Peninsula.

Fig. 9. Plunging Cliffs, West Coast of Campbell Island.
(From a photograph by R. W. Balham.)



¹⁸R. L. Oliver: 'Preliminary Report on the Geology of Campbell Island', *Cape Expedition Scientific Results*, Bull. No. 3, Wellington, 1950, pp. 7-44.

height up to nearly 1000 feet appear to plunge nearly vertically and to have undergone but little change since the late Flandrian stabilisation of ocean level (*Fig. 9*).

Against the sheer, plunging lava cliffs of the faceted spur-ends of Banks Peninsula the eroding power of waves of the sea is very small. It is not negligible, however, on the less steeply inclined sides of some of the spurs separating drowned valleys, which are not in all cases steep escarpments (*Fig. 10*). These have been attacked, especially where

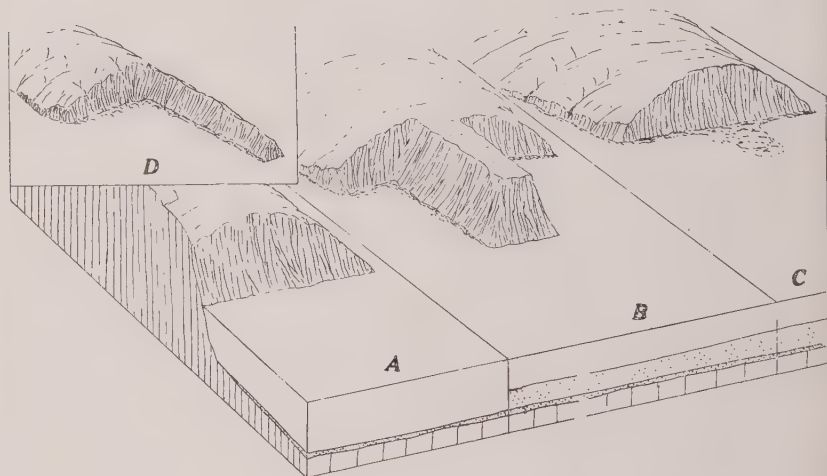


Fig. 10. Cycle of Marine Re-erosion of Plunging-cliff Facets.

A: Initial plunging cliffs.

B: Attack by waves at the sides of a cliff-faceted spur where the plunge is less steep than at the base of the facet.

C: A new facet has been developed.

D (inset): Incompletely truncated spur-end of the kind developed on the north coast of Banks Peninsula, where wave attack is vigorous on the eastern side of the spur only (cf. *Fig. 11*).

facing towards the open sea, and a number of examples are to be seen of an intermediate stage in a cycle of development of spur-end facets (*Fig. 10, D*; and *Fig. 11*). Absence of wave-cut platforms in front of the cliffs in most cases makes it doubtful whether this process has operated in the current cycle. In front of some of the plunging spur-end facets there are, however, outlying rocks (*Fig. 11*); but some at least of these may have survived from the last interglacial or interstadial age.

The building of spits and bars to bridge the bay mouths has not yet begun on those parts of the peninsular shoreline where the material

for their construction must be of local origin. Where, on the other hand, sand and gravel have been abundantly available owing to supply from extraneous sources, such as that brought by alongshore drift, extensive bars tie the former island to the mainland and encroach by progradation on its embayed outline, especially on the southern side. There one of the largest bays has recently been converted into a fresh-



Photo: V. C. Browne.

Fig. 11. Northern Coast of Banks Peninsula.

Plunging cliffs and incomplete spur-end truncation are characteristic (cf. Fig. 10). Not only do the initially-plunging spur-end facets reflect waves, but there is also an absence of concentration of wave energy on the points by refraction, the sea floor being here quite flat.

water lake (Lake Forsyth) by extension of a gravel foreland across the bay mouth (Fig. 8).

Impalpable muddy sediment, which also forms flat floors in the bays on that side, settles down with a sensibly horizontal surface north of Banks Peninsula in water sheltered from the scouring effect of the northward alongshore current (Fig. 8). This shallowing of a large area of the marginal shelf by upbuilding to a depth of twelve fathoms might imply, as Davis has noted,¹⁹ a considerable lapse of time since

¹⁹ W. M. Davis: *op. cit.*, p. 153

the cessation of the transgressive submergence; but in any case extremely rapid accumulation must be assumed. (Compare the offshore profile drawn in *Fig. 6, B.*) Whether the shelf has been built up to about its present profile and depth of water in each interglacial age of high sea level, and to what extent it has been cut away by erosion, marine and subaerial, working to the low base levels of glacial ages, are questions to which no answers can be given in the present state of our knowledge.

THE CITRUS INDUSTRY OF THE COOK ISLANDS*

W. B. JOHNSTON

POSTWAR scientific investigations within the Pacific Ocean have focused attention on the underdeveloped island groups. In the extensive field of economic development, energy and action are being directed towards increased productivity and

a fuller contribution by the islands to world prosperity. A second object is to broaden the agricultural base of island economies, hitherto narrowly confined to a small range of crops, dependent on restricted outside markets, quasi-monopolistic in character and subject to marked fluctuations in demands as well as prices. With these commercial aspects are associated the humanitarian aims of contemporary political administrators who seek to guide and aid the local native peoples in their adjustment to difficult postwar commercial conditions. Throughout the underdeveloped areas there is a growing national consciousness and an increasing impatience with existing social, political and economic inequalities; to these immediate problems and their wider implications, the developmental programmes are being more closely attuned.¹ New Zealand, in turn, has her own responsibilities in the underdeveloped islands of the Pacific Ocean; in particular, in the Cook Islands—the tropical, insular, tenth ‘province’ of the dominion.

The basis of the welfare of the fifteen thousand inhabitants of the Cook Islands is the soil. Conservative tilling of the soil and productive cultivation of tropical and subtropical crops are necessary features in a progressive standard of living for these island people, but progress



Fig. 1. Rarotonga and the Cook Islands.

*This article covers one aspect of fieldwork carried out in the Cook Islands during 1950, and grateful acknowledgement is made to the officers of the Department of Agriculture at Rarotonga for their willing cooperation.

¹ See J. E. Orchard: 'ECA and Dependent Territories', *Geogr. Rev.*, Vol. 41, No. 1, January 1951, pp. 66-87.

whether it be social, political or economic, is hampered by agricultural depression. Yet in the adjacent groups of New Zealand's 'Pacific Island Neighbourhood' agricultural prosperity during postwar years is equally apparent.² The handicapped position of the Cook Islands is an outgrowth of the 'peaceful' years following the 1914-1918 war, but the recent conflict has not left them unaffected although direct action did not touch their shores; indirectly, prewar problems were accentuated and new ones introduced.³



Fig. 2. The Pattern of Land Use. Rectangular orange plots and coconut palms provide the most significant elements.

In this kaleidoscopic setting detailed examination has been made of the citrus industry for oranges are the major long-term commercial crop. Orange trees cover an impressive area of the cultivated coastal plains and valley floors of the six permanently-inhabited volcanic or 'high' islands of the Southern or Lower Group which, areally and productively, are the most important of the Cook Islands⁴ (Fig. 1). On the principal island of Rarotonga rectangular groves of geometrically-

² Two published accounts of postwar visits and research in the island groups adjacent to New Zealand interpret the general position: Kenneth B. Cumberland in 'New Zealand's "Pacific Island Neighbourhood": The Postwar Agricultural Prospect', *N.Z. Geographer*, Vol. V, No. 1, April 1949, pp. 1-18, deals specifically with Fiji, Tonga and the Cook Islands. G. S. Peren in 'Agriculture of Samoa, Cook Islands and Fiji', *Massey Agricultural College Bulletin*, No. 20, 1948, includes Western Samoa.

³ See Cumberland: *op. cit.*, especially pp. 1-8.

⁴ These are Rarotonga, Aitutaki, Atiu, Mitiaro, Mauke and Mangaia.

spaced orange trees, nestling on the coastal slopes which fall away from the rugged volcanic core and the razorback, radiating ridges, form a characteristic and repeating cultural feature of the landscape (Fig. 2). They appear somewhat paradoxical in the land-use pattern where umbrella crowns of coconut palms and numerous patches of high weeds and of straggling scrub obscure the closer cultivation of undercrops. The irregular and commonly weed-infested handkerchiefs of communal native agriculture contrast with the well-tended



Fig. 3. Wild Oranges and Weeds. Tomatoes are grown periodically in clearings such as these.

appearance and systematic arrangement of the groves of cultivated oranges which, though owned by individual natives with an independent land title, are managed by the extension workers of the Department of Agriculture. Yet another cultural variant is the scraggy and elusive wild orange tree, dispersed haphazardly amidst family plantings of manioc, taro tarua and tomatoes, or amongst the weed and scrub cover of temporarily-abandoned land, or yet again, isolated in the broken forest cover of the more inaccessible valleys and slopes (Fig. 3).

ORANGES: WILD AND CULTIVATED

The citrus industry has long been important in the agriculture of the high islands of the southern group, but it is virtually that of the cultivation of the sweet orange. Other citrus fruits—tangerines, grape-

fruit and lemons—are insignificant. The changing patterns and vicissitudes of tropical land use in general are to be found in the character of the citrus industry of the Cook Islands which moreover illustrates a few of the many vexatious problems which confront the tropical agriculturalist on many Pacific islands—involved traditional communal forms of native land tenure; unenthusiastic native cultivators, apathetic to changing economic conditions; uninspired administration and belated agricultural policies; irregular and inadequate shipping facilities for the efficient transport of perishable export crops, and the accompanying crop wastage and frustration to the unworldly growers.

A fundamental distinction must be made between cultivated and wild oranges. Only since 1939, when the first citrus replanting scheme was introduced, have orange trees been systematically planted and scientifically cultivated to produce high-grade fruit of standard quality. Hitherto they had been grown haphazardly from seedlings and subjected to limited, if indeed any, careful management. Neither the present location of the remaining trees among the forest or in open groves, nor their size or shape allows the application of modern methods of cultivation. Disease, especially discoloration of the fruit by fungoid growth, lowers the shipping quality and market value. Spraying is uneconomic because of the dispersed distribution, while the irregularity of location combines with remoteness and inaccessibility to compound the harvesting costs. Many of the trees are now dying of old age and, with general overmaturity, a rapid decline in yields and a fall in citrus exports is evident.⁵

FLUCTUATING EXPORT TRADE

In past years wild oranges—the common ‘island’ oranges—constituted almost all the citrus exports, and even at present they are overwhelmingly dominant. (See *Fig. 6.*) In total quantity and value the export of citrus fruit shows marked annual variations, a reflection, *inter alia*, of irregular transport services to the New Zealand market, changing market conditions and fluctuating crop yields. The impressive growth of the citrus trade from the meagre exports of the 1890’s to the climax in the 1920’s has been followed by an equally sharp downward trend until the quantity now exported barely equals that at the turn of the present century. The decline in exports reflected the

⁵ Attention was drawn to this in 1937. See W. M. Hamilton: ‘A Preliminary Survey of the Citrus Industry in New Zealand’, *N.Z. Dept. of Sci. and Indus. Res. Bull. No. 53*, Wellington, 1937, pp. 193-195.

decreasing yields as trees passed the mature bearing stage. To say the least, it was disastrous. A staple export trade and a chief source of internal and external purchasing power was being rapidly limited; indeed extinction threatened an important limb of the islands' economy. This unsatisfactory position was the subject of a parliamentary report in 1936 which directed wider attention to the decadent state of the orange trees and to the detrimental trading methods and marketing conditions within the industry.⁶

A POLICY OF REJUVENATION

The inherent disinterest of the Polynesian native in the continuous and careful cultivation of the new orange plantings for the relatively long period of six years before a financial return was possible, has been accentuated by new interests. The tomato-growing industry has proved a popular alternative since it involves short-term labour and offers the advantage of a considerable profit under favourable market conditions. Moreover the speculative nature of the crop has added attractions for the imaginative native mind. The extensive clearing of land in wild oranges and weeds for seasonal plantings of tomatoes took place during the 'thirties. In addition, widening opportunities for earning wages detracted from the traditional dependence on the soil. Permanent and casual employment with the Department of Agriculture, in administrative offices, as wharf labourers, in teaching and in medical occupations diverted many land occupiers and supplied the monetary means for the purchase of numerous commodities from the trading stores. During recent years, the increasing resort of the islanders to the trading store for tinned foodstuffs, clothing and other materials has imposed greater competition on wage employment and the sources of ready cash. In 1950 more than three hundred Cook Islanders were labouring on the phosphate island of Makatea in the Tuamotu Group;⁷ at least treble that number had migrated to New Zealand.⁸ Here is reflected the growing demand for immediate money incomes from wages and short-term crops; in neither case is there a healthy sign for a rejuvenation of the moribund citrus industry.

See 'Report on the Cook Islands Fruit Industry', *Append. Journ. House of Repres.*, (H-44A), Wellington, 1936.

⁶ 'Cook Islands (Annual Report), 1950', *Append. Journ. House of Repres.* (A-3), Wellington 1950, p. 4.

⁷ Some 2000 islanders from Western Samoa, the Cook Islands and Niue Island are now resident in New Zealand. See 'Department of Island Territories (Annual Report), 1950', *Append. Journ. House of Repres.* (A-5), Wellington 1950, pp. 10-11.

The inaptitude of the native economy for crops involving individual labour over extended periods and the new commercial forces demanded that the administration, through the Department of Agriculture, should inaugurate replanting schemes. Private enterprise offered little; the few European plantations which had survived the economically unstable years of the 'thirties were, on the whole, weed-infested and the planters disinterested in new ventures. The sense of frustration aroused by the profiteering action of local trading firms, native ignorance of market demand and supply, transport problems, and unsound marketing techniques all combined to enforce a policy of rejuvenation.

SHORT-LIVED SCHEMES

The disinterest of the natives resulted in the introduction, in 1939, of an administration-sponsored replanting scheme. For those land occupiers who were able to show a clear title to an area suitable for planting, credit was made available for plants and equipment. In the proposal the grower was to cultivate the plot and the advances were to be repaid by deductions made from the sale of the crop once the trees reached bearing age. The scheme was virtually still-born; agitation against replanting arose out of difficulties concerning customary land titles.

With the rejection of the initial scheme by the native growers, a second proposal included the lease by the administration of one hundred plots, each of one and a half acres. The administration was willing to plant and cultivate the orange groves and pay the land owner an annual rental of £1. Once cropping began, half the proceeds were to go to the owner, and half to the administration in payment of the expenses incurred. After fifteen years the land was to be returned to the original owner even if expenses were still outstanding. Initially the scheme was favoured but rejection soon became apparent in the lack of enthusiasm shown by the natives.

The core of the problem was again that of land tenure, for the threat of permanent violation of the traditional ownership as embodied in the *kopu tangata* on Rarotonga was apparent in the condition that the lands should be leased to the administration as security for expenditure involved in establishing and maintaining the plots. The most jealously-guarded heritage of the native is his right to the land which, by law, he cannot sell. The Cook Islanders detested leasing their land, and the administration failed to gain their cooperation.

Security of tenure was needed before any scheme to resuscitate the citrus industry could be commenced with successful prospects. Recommendations were therefore made to enable one member of the family to have, by communal agreement in the Native Land Court, a definite area of the land held within the *kopu tangata*. Consequent upon such an agreement the occupier was confirmed as the owner under Maori custom and became capable of pledging the freehold to the administration as security for financial and material advances.

THE ACCEPTED SCHEME

Under these conditions a scheme was proposed in 1945, which applied only to Rarotonga, and in which provision was made for the

TABLE I
ESTIMATED YIELD OF ORANGES FROM RAROTONGAN PLANTINGS*

Year Planted	Total No. Trees	1951	1952	1953	1954	1956	1958	1960
1945	336	336	672	840	1,008	1,444	1,680	1,680
1946	5,341		5,341	10,682	13,332	18,693	26,705	26,705
1947	1,622			1,622	3,244	4,866	6,488	8,110
1948	1,393				1,397	3,492	4,889	6,985
Total	8,696	336	6,013	13,144	19,001	28,495	39,762	43,480

* Yields, in cases of one and a half bushels, based on 1948 estimates, and supplied by the Director of Agriculture, Rarotonga.

establishment of one hundred citrus plots each of one and a half acres and containing ninety trees.⁹ Extension of the replanting scheme to the outer islands of the southern Cook Group was approved in the same year. This provided for fifty acres on Aitutaki, Mauke and Atiu respectively. Interest-bearing advances in the form of citrus trees, material, labour and the use of mechanical equipment were made to the legally-established individual owners. The encouraging enthusiasm with which the native growers adopted the scheme has led to the recent authorisation of a further fifty acres on Rarotonga and twenty-five acres on Aitutaki.¹⁰

The estimated yields in one and a half bushel cases from Rarotongan plantings are shown in Table I. The total estimated yield from all

⁹ See *Cook Islands Amendment Act*, Wellington, 1946, pp. 17-22.

¹⁰ 'Cook Islands (Annual Report) 1950', *Append. Journ. House of Repres.* (A-3), Wellington, 1950, p. 21.

plantings is 67,000 cases of fruit from Rarotonga, 33,000 from Aitutaki and 22,000 cases from Mauke and Atiu respectively.¹¹ Table II contains a conservative estimate of anticipated yields from wild trees and from present and future replantings on all the islands. The island of Mangaia remains outside the replanting scheme because of the local antagonism of powerful island chiefs, the *aronga mana*, to the Native Land Court although some progress has been made in forced replanting of budded trees, introduced from nurseries on Rarotonga, and wild seedlings.

By the end of 1950 some one hundred and fifty citrus plots had been established on Rarotonga. They are irregular in size and the number of trees planted varies although the consistent aim has been

TABLE II
TOTAL ESTIMATED ANNUAL YIELD OF COOK ISLAND ORANGES*

<i>Island</i>	1950	1952	1954	1956	1958	1960
Atiu	5,000	5,000	5,000	11,000	18,000	23,000
Mauke	3,000	3,000	4,000	13,500	18,500	24,000
Mangaia	30,000	28,000	25,000	20,000	15,000	15,000
Aitutaki	2,000	5,250	10,125	16,875	21,875	25,250
<i>Total</i>	40,000	41,250	44,125	61,375	73,375	87,250
Rarotonga	15,000	25,655	39,484	48,610	61,192	64,406
<i>Grand Total</i>	55,000	66,905	83,609	109,985	134,567	151,656

*Yields, in cases of one and a half bushels, based on 1948 estimates, and supplied by the Director of Agriculture, Rarotonga.

for each plot to conform to the size of one and a half acres containing ninety budded orange trees. The distribution of plots is peripheral to the steep, abrupt slopes characteristic of the broken land in the interior (Fig. 4). They are situated on red and brown clay loams, fertile soils which show signs of the strong weathering to be expected in the tropics. The calcareous sands of the raised reef which almost completely circumscribes the island at the coast, and the gley soils of the taro swamps are unsuited to citrus cultivation. Consequently they are avoided. In the neighbourhood of Ngatangiia both these soil types are absent and as a result the citrus plots are situated much nearer to the coast. In general the pattern of plots follows the old inner trail, the *ara metua*, which linked the premissionary villages originally sited upon terraces inland of the low-lying taro swamps (Fig. 5).

¹¹ *Ibid.*, p. 21.

On Rarotonga, a seedbed is maintained at Ngatipa for the growth of citronelle (rough lemon) seedlings. From here the seedlings are planted out in several nurseries where orange slips are budded, either late Valencia or a local adaptation, Rarotonga seedless. Final transplanting to the citrus plot completes the early stages of growth. All work on the seedbeds, nurseries and plots is performed under the supervision of the Department of Agriculture. On the citrus plots paid labour is frequently chosen from within the owner's family and even the owner himself generally prefers to receive a wage for his work and

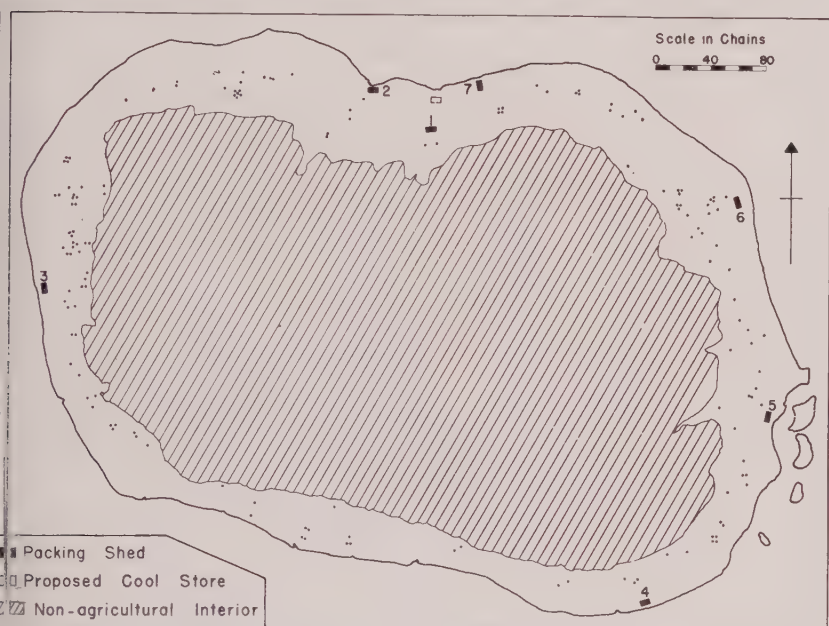


Fig. 4. Rarotonga: Citrus Plots and Packing Sheds. Citrus plots are those cultivated under the replanting scheme (one dot represents one plot). Packing sheds: 1, Tukuvaïne; 2, Avatiu; 3, Arorangi; 4, Titikaveka; 5, Ngatangiia; 6, Matavera; 7, Tupapa.

debit the immediate earnings against the future crop rather than to wait six years before the first crop matures to return a profit on work performed.

Between the trees in the citrus plot *croton* and tarapi grass are commonly intersown. Both provide an abundance of green manure to be turned in by a tractor-drawn rotary hoe or disc harrow owned by the Department of Agriculture. This method helps to maintain fertility, although the thrice-yearly interrow cultivation prevents a tall vegetation cover which has been found most suitable in maintaining fertility within tropical climates. In addition, a nitrogen soil builder,



Fig. 5. Citrus Land-use Pattern in the Arorangi District, Rarotonga.

dadup, has been introduced from Samoa and is planted between alternate citrus trees. Because of its rapid growth this tree requires frequent trimming, and the clippings provide added mulch for the orange trees. Frequent spraying for scale and insect pests is necessary and involves further use of mechanical equipment.

The distribution of cultivated and wild oranges in the Arorangi district is mapped in Figure 5. In addition to native plots within the replanting scheme, the areas of cultivated oranges include plantings by European plantation owners of orange trees purchased from the central nurseries or budded in private nurseries.

The area under wild oranges is considerably greater than that devoted to cultivated oranges. With the fruit gathered from trees scattered in the forest beyond the limits of cultivation, the crop of wild oranges still provides the overwhelming proportion of citrus production and exports (*Fig. 6*). This is true not only for the Arorangi district but for the Cook Islands as a whole. A common feature of land use is the cultivation of crops amongst the wild orange groves. Many decadent groves have been totally cleared for the new citrus plantings and many more have been decimated to make room for tomato cultivation in particular. Short-term subsistence crops or commercial crops for sale in the main settlement at Avarua and Avatiu are also commonly planted. In particular, watermelons find a profitable local market with kumaras, manioc and taro tarua as the principal family food crops. Cultivation under the trees and intercultivation are characteristic of subsistence land use in the Cook Islands.

SHELTERBELTS

Although the islands are in the zone of prevailing southeast trade winds the provision of adequate shelterbelts has only recently received attention. Attempts to provide shelter have centred on quick-growing pistache. This tree matures rapidly to reach consider-

able stature and provides extensive shelter but, in some cases, the natives have objected to its being planted. The trees have remained untrimmed and, flourishing unchecked, have now spread their wide canopies. Occupiers of land have frequently expressed their opposition

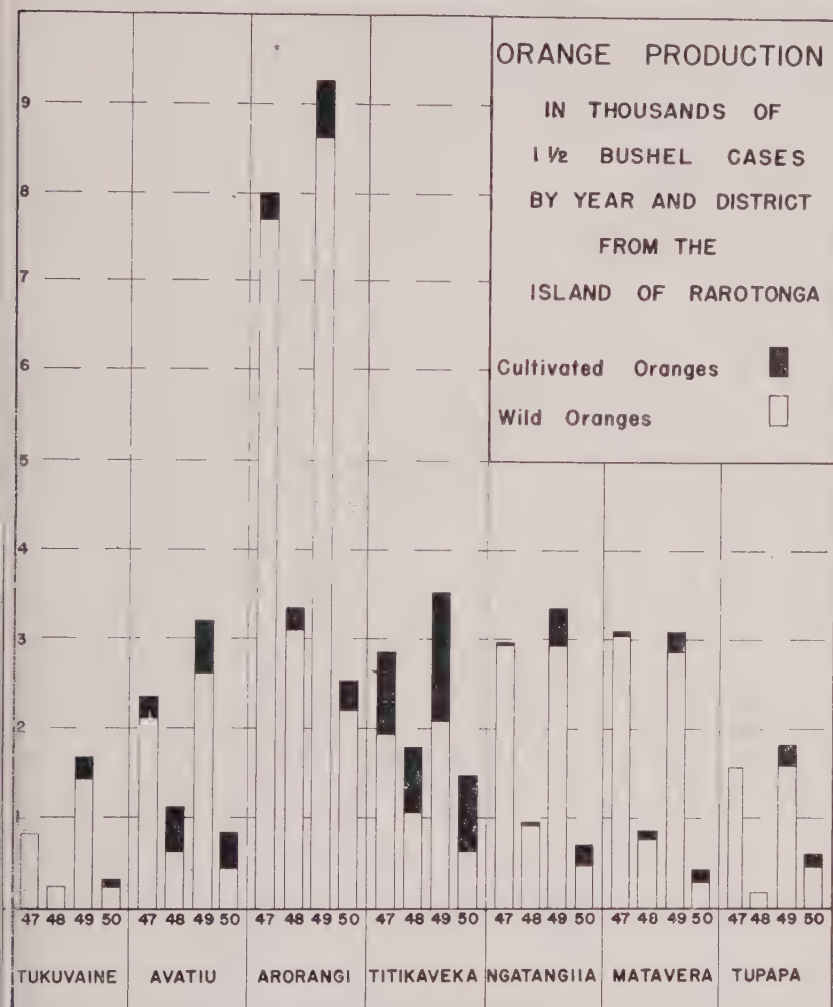


Fig. 6. Rarotonga: Orange Production by Districts, 1947-1950.

by uprooting recently-planted shelterbelts on adjacent plots. At present, many plots lack adequate protection against the harmful effects of persistent winds on future fruit.¹²

¹² In addition, a further limit is imposed on a useful source of firewood on an island already suffering less subtle defects of illogical deforestation and repeated burning of the lower slopes. Concomitant accelerated soil wastage and run-off accentuate drainage problems and heighten flood levels.

A dual purpose species, *Albizzia falcata*, has been introduced to provide shelter and yield material for the construction of fruit cases. Although still in the experimental stage, the cultivation of this tree provides a possible local alternative to the import of expensive shooks of *Pinus radiata* from New Zealand. Shooks feature largely in the list of imports and reflect the short-sighted exploitation of the islands' forest resources during the early years of fruit exports.¹³

The characteristic shelterbelt is the ubiquitous hibiscus and false coffee. Both thrive in the tropical environment of the southern Cook Group and are widely used as windbreaks in conjunction with dadup. 'Live' hibiscus trees and coconut palms are used as fence posts.

SEASONAL ACTIVITIES

The seasonal change in agricultural pursuits is oriented on the picking and packing of citrus fruit from April until July. January, February and March are occupied with the cultivating, spraying and cleaning of the citrus plots in order to reduce the work necessary during the busy cropping period. During these months fruit cases are constructed from the imported shooks in readiness for delivery to the growers. Following the orange harvest opportunity is taken to bring the work on the plots up to date and is a favourable time for new plantings.

The busiest period is, however, the seasonal picking, packing and export. From April to July, after which the fruit fly attains maximum destructiveness on the unsprayed wild oranges, nearly all families, men, women and children, are engaged in harvesting the wild oranges. The scattered distribution of the trees extends the picking time and lowers the efficiency of the labour employed. After temporary packing in the field, the full cases are taken by horse-drawn carts and waggons along clay tracks to the circumisland road, and thence to the district packing shed. Motor lorries represent a progressive element but the greatest proportion of the work is performed by man and horse. Once the systematically-planted groves of cultivated oranges come into bearing, improvements in picking and packing will occur and the efficiency of labour should increase. More effective organisation of these basic activities and more rapid transport to the packing sheds and, ultimately, to the export vessel should aid in reducing the degree of wastage.

¹³ Further, more than one third of the income from the sale of one case of oranges is needed to pay for the imported case.

Fig. 7. Loading and Lightering at Avarua, Rarotonga. On the left are the remnants of a former wharf destroyed by a hurricane.



Picking is dependent, primarily, on the projected arrival of the export ship, either a transpacific cargo vessel or interisland fruit boat. The two or three days immediately preceding the arrival is the time of maximum effort by all members of the family to fill the quota allocated to each registered grower by the Department of Agriculture, the marketing agency within the islands. Loss of time through accidents or mechanical dislocations in transport is ill-afforded and usually results in lower individual exports and a consequent decrease in income. The fruit which is ready for immediate shipment but remains unpicked will have fallen and rotted before the next vessel arrives.

PROBLEMS OF PACKING

After picking, the centre of activities moves to the seven district packing sheds located on the coastal road at convenient points accessible to local areas of production (*Fig. 4*). The packing sheds are village buildings erected by the communal effort of the district's fruit growers more than twenty years ago. As a result they are now hopelessly inadequate and fail to conform to modern standards of quality and capacity. The compulsory enforcement of grading, debuttoning to reduce stem-end rot, and gassing to preserve marketable appearance has added to problems of accommodation. Grading is inefficient, and the lack of spare parts for the machinery has led to the use of unsatisfactory substitutes.

Loading of the fruit in Rarotonga takes place at Avarua wharf where the cases are packed on slings in the lighters preparatory to being towed by launch through the boat passage in the reef to the waiting vessel anchored in the roadstead (*Fig. 7*). At some islands—Mauke and Mangaia especially—no anchorage is possible because of the great depths outside the fringing reef. The loaded lighters are rowed out by native crews who face, frequently, a hazardous crossing of

the wave-swept reef; in addition, they must lie alongside the drifting vessel while the slings are hoisted and the cases of fruit stowed in the ship's hold. This involves continual manhandling of the packed cases; hence a greater wastage of fruit by bruising and even by loss overboard is the result. The skill of the island boatmen reduces the loss and their aptitude for such toil is unequalled.

MARKETING

The report of 1936 emphasised the unsatisfactory trading methods at that time.¹⁴ Many orange growers were obliged to approach the trading stores for cash advances to permit planting and picking; additional indebtedness arose from credit given on food and material goods. The debts incurred were partially redeemed by the sale of fruit at current prices to the trading stores. Growing indebtedness because of seasonal low prices and fruit losses due to hurricanes placed an increasing burden on the growers and created a greater subservience to the trading store. Injustice to creditor growers was not unknown as the agents, who guaranteed to fill the cargo space, allotted most space to the debtor growers.

In 1940 the Fruit Control Board of Rarotonga was formed to act in the Cook Islands for the Internal Marketing Division of the New Zealand Government. The board managed the trading arrangements within the islands and by circumventing local profiteering placed the marketing on sounder competitive lines. On arrival in New Zealand the shipment of citrus fruit was distributed through the normal agencies of the Internal Marketing Division. The conclusion of the operations of this division in New Zealand, towards the end of 1950, in favour of a public fruit-distributing company has not affected as yet marketing methods within the Cook Islands.

The dependence of the citrus export trade on the uncertain schedules of a 'regular' monthly vessel and irregular transpacific cargo ships has meant considerable losses of fruit to New Zealand and of income to the island growers. Cool storage facilities are not available for preserving the fruit which ripens between the indefinite calls. An orange juice factory operates on a small scale in Rarotonga but with the decline in the citrus crop from the moribund wild orange trees and the increase in operation costs, there is little prospect of a profitable expansion of this industry until the replanting scheme reaches full development.

¹⁴ 'Report on the Cook Islands Fruit Industry', *op. cit.*, pp. 5-6.

The enthusiasm with which the replanting scheme has been implemented and its subsequent extension suggest the adoption of a new approach by the native growers to the problems of adjusting their economic systems to the impact of European land-use demands and economic methods. Yet their progress in absorbing and capitalising on postwar demands is pitifully weak. A large number of growers is still disinclined to work upon their own plots; instead they rely upon the employees of the Department of Agriculture to do the cultivation and management. Frequently those who do work seek a wage return, and fail to show any initiative.

The short-term view is evinced in the attempts by some owners to graze animals on the undergrowth within the citrus plots. In addition, the social and political disturbances during postwar years have added significant problems.¹⁵

POSTWAR CITRUS TRADE

Commodities of agricultural origin have always bulked large in the export trade of the Cook Islands (Fig. 8). At varying periods different crops have been significant; cotton and coffee towards the end of last century and bananas from 1910 to 1940, with arrowroot, candlenuts, limejuice and cottonseed as subsidiary transient items. A period of consolidation after the 1914-1918 war followed the changing composition of the internal export trade. By 1926 a dependence on three principal agricultural products was discernible. Since that year, oranges, tomatoes and copra have furnished at least fifty percent and frequently more than three-quarters of the export revenue. Prior to 1940, bananas were an important product sold on New Zealand markets;¹⁶ mother-of-pearl shell from the lagoon beds of two northern atolls has also featured periodically.

An analysis of available trading figures for postwar years emphasises the continued dependence on oranges, tomatoes and copra. The disturbing effects of the war years between 1939 and 1945, and especially new-born demands with the military influx into the southwest Pacific after 1941, are expressed, *inter alia*, in the trade of the Cook

¹⁵ See E. Beaglehole: 'Social and Political Changes in the Cook Islands', *Pacific Affairs*, Vol. 21, No. 4, December 1948, pp. 384-398.

¹⁶ Some pertinent facts in the decline of the banana trade are the disruption in ocean transport, the innovation of tomato cultivation, and the enthusiasm shown for this speculative crop by the native growers. Soil exhaustion, common in areas of banana cultivation, has played its usual role. Increasing pressure of population, especially on Rarotonga, with less cultivable land suitable for the rotation of banana areas, has also left its mark.

Islands by the temporary postwar export of native handicrafts. The continued importance and indeed rise in value of manufactured goods is promising. The encouragement of secondary industries, even on a small scale, will foster alternative sources of income. Moreover, industrial activities will open another avenue for the absorption of immigrants from the outer islands now in Rarotonga.

Copra comes principally from the coral atolls of the northern Cook Islands. In Rarotonga the demands of the natives on the coconut palm for food and for building and domestic materials make a flourishing copra industry impossible at present. From the extensive lagoon beds of two northern atolls comes the entire export of pearl shell. The southern 'high' islands with three-fifths of the total population and more than ninety percent of the cultivated land have only two arrows to their export bow—oranges and tomatoes. And both arrows are aimed at the New Zealand market.

With the exception of copra, the export of agricultural products has centred always on markets in New Zealand. In 1949 the destination of more than seventy-five percent of the exports, by value, was New Zealand; in the previous year ninety-nine percent of the export revenue was derived from New Zealand markets. Copra is now sold to the Ministry of Food in England under the terms of a nine-year contract which commenced in 1949. The United States of America provides a foreign market for pearl shell but frequently it is re-exported through New Zealand.

Citrus fruit and tomato exports supply only New Zealand markets. Tomatoes find a favourable market from July to October, the off-season in New Zealand, whilst the quality of island-grown oranges surpasses that of the New Zealand product. These two principal crops of the southern Cook Islands together occupied approximately 1075 acres in 1950, and more than seventy percent of this acreage was planted with citrus trees.

AN EVALUATION — PRESENT AND FUTURE

Nevertheless there are significant problems. Unless immediate steps are taken to increase the production of other crops, it is obvious that the agriculture of the southern Cook Islands is destined to assume more and more the character of a tropical monoculture, with all the attendant difficulties of one crop and one market. The moribund citrus industry is being resuscitated with a substantial degree of success.

It is being reoriented along sounder commercial and productive lines. From a humanitarian viewpoint it is possibly a greater accomplishment to have executed the replanting scheme without evicting the native from the land or employing him within a plantation system, which is the common resort in many tropical areas. In the process, however, the scope of agriculture has been narrowed; the citrus industry has been perched on an administrative pedestal. Because of the material and financial investments made, the administration has now a potent

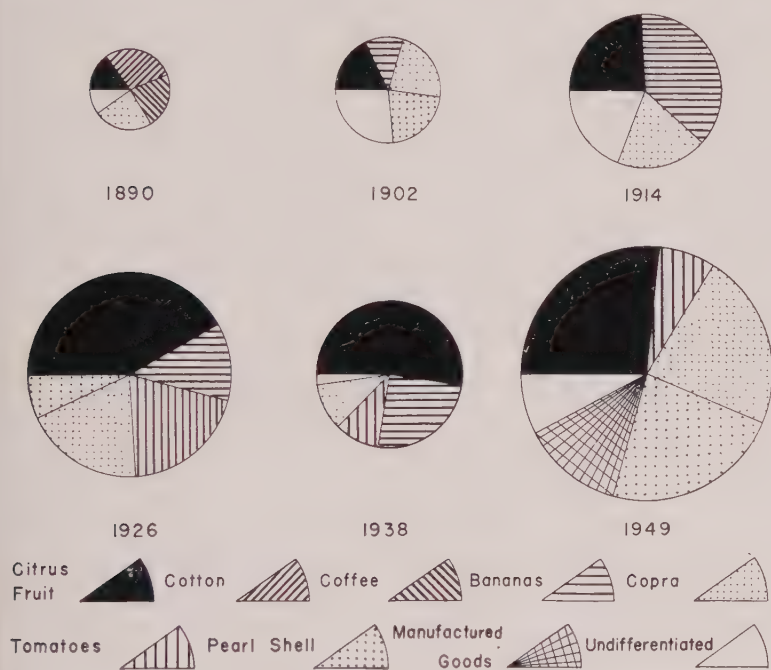


Fig. 8. Export Trade, by Value, of the Cook Islands, 1890-1949.

vested interest in the industry. It is in an irrevocable position, at least until the citrus plots come into production and repay the interest-bearing advances.

The native grower has yet to prove himself a scientific cultivator who will willingly accept responsibility for the successful management of the land according to the necessarily-enforced modern methods. The agricultural education of the natives has progressed principally by the practical demonstrations of the Department of Agriculture. Further extension work is one need. Another is the regular provision of efficient transport services with adequate cargo space for the available

crops. Modern mechanical equipment is needed for preparing the fruit for export. In particular the proposal for a large cool store capable of refrigerating the crop maturing between the arrival of ships requires immediate action to circumvent unnecessary wastage. Finally, the prospects for the reestablishment of a large-scale processing plant for orange juice as an auxiliary industry will improve as citrus yields increase.

The Cook Islands constitute an integral part of the Dominion of New Zealand, both politically and economically. The cultivation of the soil remains fundamental to native welfare. The citrus industry provides an example of how belated efforts are being made to improve the agriculture. The significant changes that have taken place already in the character of the industry emphasise the future problems. Moreover the wider implications cannot be ignored. Secure progress in the Cook Islands, whether it be social, economic or political, cannot be successful unless founded on a broad and prosperous agriculture.

GEOGRAPHY AND LAND-USE SURVEY IN THE SOUTHWEST PACIFIC: A REVIEW AND SUGGESTION

KENNETH B. CUMBERLAND

THE MEETING of the International Geographical Union held at Lisbon in 1949 appointed a commission to investigate the possibility of conducting a world land-use survey. With the financial support of UNESCO the commission met in the United States late in 1949. Its report¹ proposes the establishment of a Permanent Commission of the International Geographical Union to institute and direct a world land-use survey. The commission will have the task of organising the project, of safeguarding the consistency and quality of the work, and of establishing centres of instruction for the training of surveyors. Each country willing to participate in the proposal is to appoint a national committee, or to designate an institution, to handle the work in that country and to deal with the permanent headquarters.

The survey itself will have two immediate and prime objectives: the collection of exact data about the present status of land use throughout the world and the explanation of the existing conditions of land use. The data collected will be recorded and embodied primarily on maps on a scale of 1 : 1,000,000, and the interpretation of land-use patterns and systems will be incorporated in explanatory memoirs. The proposal arises out of a conviction that greater factual knowledge than is now available is indispensable as a proper foundation for all schemes of improvement or development of land use, especially in those areas commonly regarded as 'underdeveloped', and that this argument is reinforced by the urgency to all nations in varying degree of the problems of world population and world food supply.

LAND USE AND THE SOUTHWEST PACIFIC

The prospect of a survey of land use throughout the world makes it necessary that the present status of land-use survey in the southwest Pacific should be thoroughly reviewed and examined at an early date by the scientists—geographers amongst them—of Australia and New Zealand. Members of the commission of the International Geographical Union have already approached geographers in Australia and New Zealand with a view to their cooperation in organising the world survey. This article is offered as a review of what has already been done and of the existing situation in the southwest Pacific, as a statement of the value of geography's contribution to land-use stocktaking, and as a proposal and discussion of ways and means of organising the contribution from the southwest Pacific to the world survey.

The southwest Pacific is a region in which land-use problems could be studied at this juncture to the very great benefit not only of the people of Australia and New Zealand and the Pacific islands, but also to the advantage of all the people of

A copy of the report (entitled *The World Land Use Survey*) is deposited in the library of the New Zealand Geographical Society. See also S. van Valkenburg: 'The World Land Use Survey', *Economic Geography*, Vol. 26, No. 1, 1950.

a restless and hungry world. It is of course recognised that if there is to be a world of peace and plenty then resources must be used to the full, and at the same time conserved to the limit possible. It is not quite as widely appreciated that, if this is to be achieved, these same resources must be known and studied in relation to the techniques available for making the best and most conservational use of them. If it can be claimed that there exists a maturing appreciation of the extent of the resources of Australia and New Zealand and that many of them are used efficiently, it can by no means be said that maximum use has been achieved and that waste has been eschewed. As for the dependent territories of the southwest Pacific for which the two dominions are largely responsible, it cannot be suggested even that their resources are known in any accurate degree, and still less that it is appreciated, except in a most general sense, how they are being, or could be, used.

GEOGRAPHY AND LAND USE

To discuss land use is to discuss a matter of major geographic interest, and to outline methods of recording and explaining land use is to outline practically the whole range of a geographer's methods and techniques of regional analysis and synthesis. Geography, briefly, is concerned with discovering what places are like. It records and interprets the existence together at different places of mutually inter-related phenomena which constitute the individual character of places. In all inhabited regions the facts of land use—the basic physical resources, the use made of them (which varies, of course, in relation to the variety of economic, social and political conditions in different places), the problems that arise from use and misuse, the adjustments that are desirable to secure better use and to avoid waste—these constitute relevant material in any attempt to describe and interpret the character of areas. Land use and related phenomena are an element-complex of major interest to a chorological science differentiating in terms of spacial relationships (geographic areas) just as they are a most significant theme in a chronological science differentiating in terms of temporal relationships (historical periods). Hartshorne, whose survey of the nature and place of geography is at once the most important and most recent in the English language,² concludes that 'the land-use complex is, in fact, one of the most important, if not the most important, of all element-complexes in human geography'. In studying it the geographer must bring to bear the whole range and full force of his scientific methods, technical skills, ability and judgement.

HISTORY AND NATURE OF LAND-USE STUDY

Ever since travellers first reported, in response to a 'common curiosity', on the likeness of places they visited there have been reports on land use. But the first systematic large-scale inventory of land use based on formal and elaborate field investigation is that embraced in the Domesday Book. Working over the factual data contained in this survey historical geographers have recently been able to recreate the regional geography of England towards the end of the eleventh century. The Domesday Book also aptly illustrates an aspect of land-use survey which is often overlooked with the insistence in this modern era on the immediate practical

²R. Hartshorne: 'The Nature of Geography', *Annals Assoc. Amer. Geogrs.*, Vol. 39, Nos. 3 and 4, 1939.

utility of such inventory reports, namely the value of land-use surveys and resource inventories as historical documents of incomparable detail and completeness.

Modern methods of resource survey and physical land-classification date from the pioneer exploration of the new lands and especially of the North American interior. In the United States such work had as its objective the survey and subdivision of the public domain and were in charge of the 'Geographers of the United States'. They were followed in the 1870's by the classical 'geographical and geological reports' written under the auspices of the U.S. War Department and Department of the Interior. In Australia and New Zealand there were no similarly-organised, large-scale inventories. Exploration and reporting were done by individuals, mainly natural scientists and pioneer graziers. Australia's nearest counterparts of the formal exploratory inventories of Haydon, Wheeler, King, Powell and Gannett are the personal reports and scientific papers of Cunningham, Hume, Hovell, Sturt, Mitchell, Eyre and many others. In New Zealand the scattered papers of German scientists, especially Dieffenbach, Hochstetter and von Haast, and of others like Colenso and Brunner constitute the only preliminary surveys of land and resources until the recent era of geological, soil, agricultural and land-use surveys.

THE ROLE OF LAND-USE SURVEYS

The present phase of land-use study has developed mainly since the first World War with the realisation that resources—even land resources—are not inexhaustible, and with the growing public consciousness of the need for conservation and wiser use. It has its root in George P. Marsh's *Man and Nature: Physical Geography as Modified by Human Action* first published in 1864. Its rapid development in the last twenty years owes much to the stimulus of the depression, which heightened the demand for attempts to find cause and cure for the many physical and social ills of the land, and to the development of new systems of inventory, cartographic description and scientific appraisal, which themselves date largely from the establishment of geography earlier this century in the United States as a scientific discipline worthy of advanced study at the highest university levels. The precision, cartographic detail, value and success of the great variety of recent and contemporary land-use studies owe much to three papers published by professional geographers almost a generation ago.³ Methods of recording the diversity of areal phenomena, both cultural and physical, first outlined here by geographers are now widely employed by systematic specialists in many fields, biological and social, and by many official agencies concerned with the survey of different aspects of land and people within areas. The widespread interest in and employment of inventories and appraisals in recent years has been the result of enlightened public and administrative interests turning, in the face of serious local, national and international problems, to new tools of intelligence and the findings of scientific research.

The problems of land use cut across the confined fields of specialist systematic disciplines. They are regional problems; their complex patterns and chains of cause

³C. O. Sauer: 'Mapping the Utilisation of the Land', *Geogr. Rev.*, Vol. 4, 1919.

⁴W. D. Jones and V. C. Finch: 'Detailed Field Mapping of an Agricultural Area', *Annals Assoc. Amer. Geogr.*, Vol. 15, 1925.

⁵Derwent Whittlesey: 'Devices for Accumulating Geographical Data in the Field', *ibid.*, Vol. 17, 1927.

and effect vary from place to place. They can only be explained in terms of such different phenomena as soil textures, soil organisms, the facts of regional history, the advances of scientific plant breeding, land tenure, farm indebtedness, prestige economies, national policies and ambitions, international barriers to trade, currency systems, devaluation, and so on. They are fixed by a complex variety of inter-related influences which defy facile simplification and rapid unravelling.

The broad facts and phenomena of the physical and biological sciences have proved amenable and eminently suitable to study and explanation by scientific analysis. In such fields detailed analytical methods have brought such rich rewards that they have come to dominate. Yet one cannot be satisfied with the result in the world at large, for it has created vastly more impressive problems, especially social and political problems, than it has brought to solution. Indeed there is abundant evidence of profound dissatisfaction in scientific circles. None would claim that the chorological viewpoint and methods of synthesis of geography—the attempt to understand the interrelated multiplicity of significant phenomena in areas—can remove the dissatisfaction and provide the solutions so strongly desired. But many will claim that the chorological (and chronological) approach can assist materially in putting together again the pieces of the physical and social world which the ‘myopic’ systematic sciences have so efficiently taken apart.⁴ To gather again the distended threads into a carefully patterned fabric demands even greater skill. One is reminded of Humpty Dumpty and of the old watches taken to pieces by children. Synthesis demands abilities and intelligence no whit inferior to those required to operate analytical techniques. The chorological viewpoint of geography has its contribution to make to such tasks, especially in the field of land use, ramifying as it does over so wide a field. But geography does not reject the contributions of the systematic scientist. It welcomes his specialist knowledge and techniques and is anxious to cultivate joint efforts in area studies whether emphasising physical environment, land use, settlement, or manufacturing. The cooperative field investigation and interdisciplinary approach to the study of the problems of areas offers great promise.⁵

METHODS, SCOPE AND EXAMPLES OF LAND-USE SURVEYS

The need for the geographer’s broad chorological approach and of interdisciplinary cooperation is abundantly evident if one examines any selection of the many significant studies of land use that have been carried out in recent years.⁶ It is impossible to refer

⁴See S. W. Wooldridge: ‘Geographical Science in Education’, *Geogr. Journ.*, Vol. 109, Nos. 4-6, 1947.

⁵The interdisciplinary study of areas has been investigated in detail by the U.S. Social Science Research Council. See R. B. Hall: *Area Studies: With Special Reference to Their Implications for Research in the Social Sciences*, New York, 1947. A specific example of joint field work in which geographer, economist and anthropologist cooperated in West Africa was reported recently. See W. Fortes, R. W. Steel and P. Ady: ‘Ashanti Survey, 1945-46: An Experiment in Social Research’, *Geogr. Journ.*, Vol. 110, Nos. 4-6, 1948, and R. W. Steel: ‘Some Geographical Problems of Land Use in British West Africa’, *Trans. & Papers Inst. Brit. Geogr.*, 1949.

⁶Fortunately there are two recent comprehensive expositions of the status, techniques and areal coverage of land-use surveys. One treats fully of land classification in the United States and the other reviews more briefly land-use surveys conducted in many parts of the world (including New Zealand but not Australia). See ‘Land Classification in the United States’, *Report of the Land Committee of the National Resources Planning Board*, Washington, 1941; and G. V. Jacks: ‘Land Classification for Land Use Planning’, *Imp. Bur. Sci. Tech. Comm. No. 43*, Harpenden, 1946.

here to more than a mere fraction of the many areas surveyed or to the methods variously employed in the study of land utilisation. It will be possible to refer only to examples from the southwest Pacific and to a few other large-scale projects of field survey conducted in other parts of the world, and particularly relevant to this present discussion, for the light they throw on problems of land-use study, the successful methods employed, and their practical utility.

Methods of land-use study might, for present purposes, be considered broadly but not exclusively under two headings: generalised reports and statistical analyses of land use based largely on library research methods; and cartographic field recordings of land use and related resources and problems with accompanying explanatory reports.

A number of authoritative first-rate statements on land use in the Pacific fall into the first group.⁷ As general reports and books of reference on agricultural conditions and agrarian problems they are indispensable reading for any student of the areas in question. All of them are built on a background of first-hand field observation and in some cases are based on a lifetime of personal experience; they are written in general terms and illustrated by small-scale maps only but sometimes by lavish use of tables of statistical data. There are no such reports on land use in many of the island groups of the southwest Pacific, mainly because of lack of statistical and library sources of specialist data, but the general accounts of land use in the two dominions are as good as those available for almost any other parts of the world.

In many ways *Land Utilization in Australia* and *Agricultural Organization in New Zealand* form an interesting contrast. The former was written under the joint authorship of an agricultural scientist and an economist, and they approached their task principally from the chronological viewpoint. They explain the present use of land by the major primary industries in terms of their historical development. And each chapter has its chorological section in which each major form of land use is regionally differentiated. Its New Zealand counterpart, however, is an assembly of unrelated specialist accounts. The one is a cross-disciplinary contribution with an appreciation of the value of the correlation supplied by historical and geographical points of view; the other remains a collection of the parallel efforts of different disciplines without coordination or correlation. It is twice as long as the Australian account, but provides no integrated picture of land use at different times and in different places; it is a collection of threads not woven into a fabric.

RECORDING LAND USE IN THE FIELD

In the solution of social problems, including land-use problems, whether on an international, national or local regional scale, the carefree drift of *laissez faire*

⁷ S. M. Wadham and G. L. Woods: *Land Utilization in Australia*, Melbourne, 1929; H. Belshaw, D. O. Williams and F. B. Stephens: *Agricultural Organization in New Zealand*, Melbourne, 1936; S. Naga: *Land Utilization in Japan*, Tokyo, 1929; J. W. Coulter: *Land Utilisation in the Hawaiian Island*, Honolulu, 1933; *idem*, 'Agricultural Land Use Planning in the Territory of Hawaii', *Agric. Ext. Serv. Extension Bull.* No. 36, Univ. of Hawaii, 1940; *idem*, 'Land Utilization in American Samoa', *B.P. Bishop Mus. Bull.* No. 170, Honolulu, 1941. Three publications by the present author together constitute a review of land use and agricultural problems in New Zealand. See K. B. Cumberland: 'A Century's Change: Natural to Cultural Vegetation in New Zealand', *Geogr. Rev.*, Vol. 31, 1941; *idem*, 'Soil Erosion in New Zealand: A Geographical Perspective', Wellington, 1944; and *idem*, 'The Agricultural Regions of New Zealand', *Geogr. Journ.*, Vol. 112, Nos. 1-3, 1948.

is at an end. It has been decided—democratically decided—that community problems shall be tackled by some measure of deliberate calculation and planned adjustment. Planning, as such, is not questioned; the only matter of dispute is whether planning shall be predominantly in the form of a scientific and democratic ‘piecemeal social engineering’ or shall constitute wholesale, totalitarian ‘Utopian social engineering’.⁸ But whatever the form planning takes and whatever the rate of effectuation, whether in the U.S.S.R. or the U.S.A., to be successful it must be based on accurate and detailed knowledge. A much greater wealth of fact and understanding than is now available is imperative, although all the facts will never be known and in consequence planning and prophecy will never be without mistakes. Even with ‘planning’, advance must be by means of trial and error, by advancing theories of social improvement and testing them by experiment. This is no less true of land-use planning than of other matters; no less true of the southwest Pacific than of East Africa.

It was the urgency of assembling detailed factual information about areas that led, in the last twenty years, to the elaboration of a variety of methods of collecting and recording such information, and to the attention given in many parts of the world to land-use surveys and resource inventories. Such surveys have as their objective some combinations of the following aims:

- (i) to survey land in terms of its inherent physical characteristics: its rocks, soils, slopes, minerals, climates, water resources, etc.;
- (ii) to survey land in terms of the uses to which it is put at present, including the suitability or otherwise of such uses in relation to the inherent physical properties of the land (the proposed World Land-Use Survey falls into this category);
- (iii) to survey land in terms of the uses to which it is capable of being devoted provided social and economic conditions allow;
- (iv) to survey land in terms of desirable or recommended use under given social and economic conditions; and
- (v) to survey land in terms of when and how its use is to be changed to fit a plan already decided upon.

The first three methods and objectives fall within the province of scientific investigation. All are objective surveys; the first two provide primarily descriptive inventories and neither make recommendations nor formulate action programmes. The third type makes no recommendations but is interpretative to the extent that it predicts what can be expected if land is to be used in this way or that. Types (iv) and (v), however, involve technical decisions in the light of political or administrative policy. Both are based on surveys involving the methods and objectives of types (i), (ii) and (iii). The first three involve objective recording and are well within the sphere of geographic interest; the others involve subjective decision and are part of social engineering. Here only those methods of land-use study can be considered that take the form of scientific measuring and objective recording and interpretation.

THE LAND UTILISATION SURVEY OF BRITAIN

The Land Utilisation Survey of Britain has been the most ambitious and successful of the surveys of the second type. It has provided a modern Domesday Book. In

⁸K. R. Popper: ‘The Poverty of Historicism’, *Economica* (N.S.), Vol. II, 1944.

less than ten years it has provided an accurate and detailed cartographic record of the use to which every field in England, Scotland and Wales was put. These uses are depicted on some 235 one inch to one mile maps and on thousands and thousands of six inches to the mile field sheets. They are interpreted (in relation to the inherent physical conditions and superimposed social and economic patterns) in no less than ninety-two full length county reports; and again in *The Land of Britain: Its Use and Misuse* which constitutes a final definitive volume of over 500 pages and is written by the Director of the Survey.⁹ This monumental geographic contribution to a national stocktaking is the work of never more than a dozen salaried organisers and cartographers, together with thousands of voluntary workers—professional geographers, members of university staffs, students and school pupils. It was devised and undertaken to satisfy an 'idle' curiosity, to fill a gap in the precise information on the distributional aspects of land use and agricultural geography of Britain. It had, at first, no utilitarian ambitions. Its practical utility, however, has already been more than adequately demonstrated. With the wartime need to reorganise British agriculture, the British Government hurried the completion of the survey by generous financial grants and the Ministry of Agriculture made use of the survey's work in its planning. Subsequently the survey has given Britain a more complete detailed and accurate basis for the planning of urban and rural land use than any other country possesses. The maps and reports of the survey are being used on all hands by agriculturalists, educationists, town regional planners, the Ministry of Town and Country Planning, local authorities and many others.

LAND CLASSIFICATION IN THE U.S.A.

In no country are so many agencies aware of the utilitarian aspects of land-use survey and in none are so many agencies active in this field as in the United States. Several federal agencies conduct parallel surveys with different emphasis. A recent report lists no fewer than sixteen land classification activities currently being conducted under the auspices of the (U.S.) Department of Agriculture, and seventeen under the direction of the Department of the Interior.¹⁰ State agencies (universities, agricultural colleges, extension services, and planning authorities) also conduct land appraisals, and one special agency (The Tennessee Valley Authority) itself finances eight elaborate surveys of different aspects of land use within its own territory which has an area considerably less than that of New Zealand. The Land Classification (formerly Geography) Section of T.V.A. has devised special methods of survey and classification of the composite physical conditions of land and the economic and social aspects of land use.¹¹ These methods, because of their application to areas for which accurate topographic maps are not available, the wealth and diversity of information collected and the speed with which large areas may be mapped, warrant special consideration in the southwest Pacific. The method applies the 'fractional code notation'¹² to 'unit areas' of not less than 200 acres. By focusing

⁹Professor L. Dudley Stamp of the University of London. Professor Stamp is a member of the International Geographical Union's Commission on the World Land Use Survey.

¹⁰'Land Classification in the United States', *Report of the Land Committee of the National Resources Planning Board*, Washington, 1941, pp. 26-34.

¹¹See G. D. Hudson: 'The Unit Area Method of Land Classification', *Annals Assoc. Amer. Geogr.*, Vol. 26, 1939.

¹²See Jones and Finch: *op. cit.*

attention on the area or region as a unit of investigation and by recording a wide range of facts, natural and cultural, all of them significant to problems of land use, the unit area method of agricultural survey employs an essentially geographical approach to land problems. It has been adapted to New Zealand conditions,¹³ and has been successfully employed by the North Canterbury Catchment Board in the investigation of soil erosion problems associated with the use and misuse of both mountain grazing lands and lowland areas of intensive arable and pastoral farming.

LAND-USE SURVEY IN THE SOUTHWEST PACIFIC

Australia and New Zealand can show nothing to compare with the successful, large-scale, finely-detailed surveys of land use employed in recent years particularly in Britain and the United States. And while Australia and New Zealand have but a small collection of the results of unrelated attempts in small areas to map land use, the Pacific island territories have practically none at all.

This does not mean that there exists no detailed data about contemporary patterns of land use in the southwest Pacific. There are admirable (if incomplete) records—on maps, in statistical tables and in reports—of certain specific aspects of land. Modern topographic maps today provide coverage for increasing areas. The recent war stimulated this work, facilitated the wider use of photogrammetry and accelerated the publication of map sheets. In this respect New Zealand is relatively better equipped than Australia. There are now available in the dominion maps which provide coverage on a scale of 1 : 63,360 for all the more intensively utilised areas (or approximately two-thirds the total area) and on a scale of 1 : 25,000 for major urban and suburban areas. Many of the Pacific island groups were also provided during the war with provisional coverage. Many of these topographic sheets record the distribution of certain broad categories of land use—forest, grassland and plantations especially are usually well depicted, and so too, for populous areas, is the extent and pattern of urban land use.

The geological surveys of Australia and New Zealand, if not of the island groups, have accurately recorded for many areas certain inherent natural properties of the land, and in more recent years these have been extended by the field work of soil scientists, agrostologists, agronomists, irrigation, hydroelectric, road and railway engineers.¹⁴ In total, the work is of formidable proportions, but it is almost completely uncoordinated within any one region, provides very unequal coverage as between regions, and is frequently deficient in terms of the extent to which it is satisfactorily recorded on maps.

From the point of view of land use in the narrower sense, soil scientists have made

¹³K. B. Cumberland: 'The Survey and Classification of Land in New Zealand: A Basis for Planning', *Trans. & Proc. Roy. Soc. N.Z.*, Vol. 74, 1944.

¹⁴Amongst generalised surveys of pastures, crops and cultural vegetation (reflecting land use) which provide wide and uniform areal coverage, the following should be noticed: A. McTaggart: 'A Survey of the Pastures of Australia', *C.S.I.R. Bull. No. 99*, 1936; J. A. Prescott: 'The Vegetation Map of South Australia', *Trans. Roy. Soc. S.A.*, Vol. 53, 1929; *idem*: 'A Soil Map of Australia', *C.S.I.R. Bull. No. 177*, 1944; F. W. Hilgendorf: 'Grasslands of South Island, New Zealand', *N.Z. Dept. Sci. & Ind. Res. Bull. No. 47*, 1935; E. A. Madden: 'The Grasslands of the North Island of New Zealand', *N.Z. Dept. Sci. & Ind. Res. Bull. No. 79*, 1940; K. B. Cumberland: 'A Century's Change: Natural to Cultural Vegetation in New Zealand', *Geogr. Rev.*, Vol. 31, 1941.

the most valuable contribution, in Australia mainly by detailed but scattered application of their techniques, and in New Zealand and Fiji by general extensive reconnaissance surveys of soil and related phenomena. The detailed, sporadic, local soil surveys in Australia have been published mainly by the C.S.I.R. as bulletins, sometimes under the title of 'Soil and Land-Use Surveys'.¹⁵ More valuable as a contribution to land-use survey, however, is the method employed in the last few years and the maps produced on a scale of 1 : 253,440 by the New Zealand Soil Bureau. This has been fully reported elsewhere.¹⁶ In New Zealand certain small areas have been studied in greater detail by official agencies. On occasions their work has been published. It has usually taken the form of compartmentalised reports with short separate chapters contributed by pedologists, agriculturalists, horticulturalists, botanists, climatologists, entomologists, and others.¹⁷

DETAILED MAPPING OF LAND USE LIMITED

Field by field mapping of contemporary land use *per se*, comparable in scope, objective and method to the work of the Land Utilisation Survey of Britain, of the Land Classification Section of T.V.A., or of the United States Soil Conservation Service, is restricted to one or two isolated attempts to experiment unofficially with similar methods in areas infinitesimal in size in comparison with the area of the dominions and their dependent island territories. An appeal for the inauguration of such detailed investigations was made as long ago as 1933 by Professor Macdonald Holmes, but little has been done.¹⁸ His colleagues and a number of his students have subsequently made small but isolated surveys.¹⁹ Such work has been restricted to geographers—to students working for postgraduate degrees and members of university staffs working in the field during so-called 'vacation' periods—all restricted by lack of facilities and finance. Since geography was accorded full university status in New Zealand during the war similar studies have been undertaken. In three different departments of geography detailed mapping of land use is undertaken by third year students in practical field courses, and in addition, more than twenty

¹⁵See, for example: 'The Soils of Tasmania', *C.S.I.R. Bull. No. 139*, 1941; 'A Soil and Land Use Survey of the Hundreds of Riddock, Hindmarsh . . . , South Australia', *C.S.I.R. Bull. No. 142*, 1941; 'The Soil and Land Use Survey of the Wakool Irrigation District, N.S.W.', *C.S.I.R. Bull. No. 162*, 1943; 'A Soil, Land Use and Erosion Survey of Parts of County Victoria, South Australia', *C.S.I.R. Bull. No. 188*, 1945.

¹⁶L. I. Grange: 'A Basic Scheme for Land Classification', *N.Z. Journ. Sci. & Tech.*, Vol. 26A, 1944. This proposal is reviewed in Jacks: *op. cit.*, p. 56. When the generalised soil survey is made, auxiliary information is collected (but not mapped) so that the soil types may later be grouped into six fertility or use-capability classes. This thus constitutes a use-capability survey based on inherent physical land qualities, especially natural soil fertility estimates. It is now almost complete for the whole dominion and maps and reports have already been published covering the North Island.

¹⁷See especially: 'Farm Management Survey of Ashburton County', *N.Z. Dept. Sci. & Ind. Res. Bull. No. 58*, 1938; 'Land Utilisation Report on the Heretaunga Plains', *N.Z. Dept. Sci. & Ind. Res. Bull. No. 70*, 1939; 'The Soils and Agriculture of Part of Waipa County', *N.Z. Dept. Sci. & Ind. Res. Bull. No. 76*, 1939; 'Soils and some Related Agricultural Aspects of mid-Hawkes Bay', *N.Z. Dept. Sci. & Ind. Res. Bull. No. 94*, 1947; 'Soils and Agriculture of Westland, New Zealand' *N.Z. Dept. Sci. & Ind. Res. Soil Bureau Bull. No. 2* (N.S.), 1950.

¹⁸J. Macdonald Holmes: 'Land Utilisation', *Austr. Geogr.*, Vol. 2, 1933.

¹⁹See especially W. H. Maze: 'Land Utilisation in the Lower Hunter Valley, N.S.W.', *Austr. Geogr.*, Vol. 2, 1933-34; and A. G. Lowndes and W. H. Maze: 'Land Utilisation Regions of Tasmania', *Univ. of Sydney Publ. in Geog.*, No. 4, 1937.

M.A. and three Ph.D. candidates have completed, or are actively pursuing, land-use mapping in both urban and rural areas. Most of this recording has been in accordance with a system of classification which is an adaptation to New Zealand conditions of the system of the Land Utilisation survey of Britain—and results are comparable.²⁰ Some of it has already been published.²¹ The New Zealand adaptation of the 'unit area' method of land classification has been applied to over 1000 square miles of Canterbury and results reported to the North Canterbury Catchment Board but not published.²² A further modification of the British system, an adaptation suitable for use in areas of native subsistence agriculture, was used by the present writer to map land use in the vicinity of Titikaveka, Rarotonga, in 1948. The manuscript maps provide a very realistic impression of the very different patterns of land use which such tropical insular regions provide. As far as is known, no other detailed mapping of land use in the dependent territories of the southwest Pacific has been made, although specialist cartographic recordings of certain aspects of land use were made by geographers cooperating with anthropologists in the C.I.M.A. (Coordinated Investigation of Micronesian Anthropology) project conducted since the war in the United States Trust Territories of the Pacific.²³

THE NEED FOR LAND-USE RESEARCH IN THE SOUTHWEST PACIFIC

This is not the place to argue the general case for the study of land use; it is enough to review the work in progress, to emphasise its merits as an academic exercise and to refer to its role in 'pure' scientific research; it is sufficient to point not only to its immediate utilitarian and economic benefit but also to its future value as a precise incomparably detailed historical document.²⁴ In no country has greater use been made of land-use surveys—and of the geographer's contributions to the collection and interpretation of the factual data about areas—than in the United States. It is perhaps significant that since the war the United States has undertaken, and is actively financing and directing, very large-scale resource appraisals and land-use classifications—under the auspices of the Departments of the Interior, of the Army and of the Navy—in Alaska, Japan and the Trust Territories of the Pacific.

Australia and New Zealand are rapidly growing to maturity amongst the nations.

²⁰The classification hitherto employed by geographers in New Zealand accords in detail with the 'classification of categories of land use to be recognised and mapped' by the World Land Use Survey.

²¹F. Parks: 'Land Utilisation in Metropolitan Christchurch', *N.Z. Geographer*, Vol. 2, No. 2, 1946; J. W. Fox and R. G. Lister: 'The Galatea Basin', *ibid.*, Vol. 5, No. 1, 1949; J. W. Fox: 'Te Kuiti and the Northern King Country: A Region of Agricultural Transition', *ibid.*, Vol. 6, No. 2, 1950.

²²But see W. P. Packard: 'Lake Coleridge Catchment: A Geographic Survey of its Problems', *N.Z. Geographer*, Vol. 3, No. 1, 1947; K. B. Cumberland: 'The Survey and Classification of Land in New Zealand: A Basis for Planning', *Trans. & Proc. Roy. Soc. N.Z.*, Vol. 74, 1944; and K. W. Robinson: 'Classifying Land: Field Work in Secondary Schools', *N.Z. Geographer*, Vol. 2, No. 1, 1946.

²³See R. E. Murphy: 'Land Ownership on a Micronesian Atoll', *Geogr. Rev.*, Vol. 38, 1949.

²⁴The success of soil conservation in the United States is based on the detailed investigation of land use on thousands of farms, the measuring of land capabilities and the adaptation of practices to inherent qualities of the land. On thousands of farms and millions of acres soundly-based conservation programmes have raised production by twenty percent, resulting in increases of farm income and taxation revenue amounting to millions of dollars. See H. H. Bennett: 'More Food from Soil Conservation', *Soil Conservation*, Vol. 8, 1943 and *idem*: 'Adjustment of Agriculture to its Environment', *Annals Assoc. Amer. Geogr.*, Vol. 33, 1943.

They have recently become aware of the national and international responsibilities involved in this, and they have come to base their internal and external policies upon recognition of these responsibilities. Their role in the United Nations is evidence of this. So too are the Canberra Pact, the South Pacific Commission (for which the dominions are largely accountable) and the trusteeship agreements (which both of them have signed). To discharge their enlarged, and now more fully-realised, responsibilities both dominions must know their own territories. Areal knowledge becomes increasingly significant to people, politicians and planners alike. Australia and New Zealand must know the extent of their own physical and cultural resources and of those of the trust territories and of the island groups under their jurisdiction. Most important of the physical resources is the land and its soil cover. Before it can be fully used and conserved its present use must be fully known and understood. Both dominions are in process of consolidating the agricultural progress of a century. The frontier has almost been reached, occasionally overstepped, and intensification of the use of existing farmland holds greatest promise. Land already occupied is the frontier of the future. It is imperative to know how well or badly it is now being used.

ISLAND TERRITORIES

The dependent territories are rapidly emerging from a neolithic culture and subsistence agriculture to take a fuller part in a world of manufactured gadgets, canned foods, international trade and monetary economies. This metamorphosis cannot be eased, living standards raised or the innumerable problems of the indigenous peoples of the islands of the southwest Pacific solved unless the areas and people in question are known. To study land uses in these territories is to study all but a few specialised phases of their geography. To understand existing patterns of land use is to understand much of both land and people, both habitat and society. Land use is the core of area studies and research.

Emphasis must inevitably be placed more and more upon Indonesia, New Guinea, the Solomons, New Caledonia, Fiji and even the lesser island territories of the Pacific. As the mid-latitudinal agricultural frontiers fill up at the same time as the demand for both foodstuffs and agricultural raw materials continues to expand in response to unprecedented population growth, industrialisation and efforts to furnish higher living standards, the potentialities of tropical lands and tropical soils come into greater prominence. If the world is to be fed, and if the objective of freedom from both fear and want is to be attained, their latent possibilities must be explored and developed. This was fully appreciated at the recent conference of the United Nations on the Conservation of Resources.²⁵ It was agreed that the total knowledge of tropical regions, of their soils, agriculture and land-use practices, is very small indeed, and that one of the most pressing needs is to fill the more obvious gaps as soon as possible.

In the island territories of the southwest Pacific researchers in these spheres have an almost virgin field to plough. With their multifarious physical contrasts in size, location and structure, with alien plantation economies, untouched native economies and some indigenous agricultural and land-use systems in a state of rapid transformation, with their varied ethnic groups and cultures, their local problems of land use,

²⁵See below in *Geographic Notebook*, p. 174.

overpopulation and underdevelopment, soil erosion and resource exhaustion, they provide a field for area research which not only demands urgent attention, but offers fascinating problems worthy of the interest and efforts of workers in many disciplines with the highest qualifications and abilities.²⁶ If the contributions of such specialists can be coordinated from the first, the prospects of early results of great value are very bright indeed.

SUGGESTIONS

The decision to organise a world survey of contemporary land use opens up an opportunity for much more systematic work in Australia and New Zealand and their dependent territories. Local developments within the two dominions and the island territories of the southwest Pacific make the time and opportunity even more favourable. The governments of the commonwealth and the dominion have recently committed themselves in terms of the so-called Canberra Pact to foster the interests not only of the peoples of the dominions but also of the dependent territories. By virtue of articles IV and VIII of the South Pacific Commission Agreement (1947), they have further undertaken to 'arrange . . . for the carrying out of research studies—using existing institutions where appropriate and feasible' into problems, including land-use problems, upon the solution of which the welfare of the indigenous peoples depends. The Colonial Office, too, is more active in such matters than before, and through the Colonial Welfare Corporation and Colonial Welfare Fund is intent upon subjecting the land problems of the colonial territories to detailed investigation. In East and West Africa such research is well under way; in the Pacific, especially in Fiji, it has recently been commenced.²⁷

With these developments and favourable prospects in mind, one is inclined to contemplate what might be done in the next generation. What follows is one view, a geographer's view, of desirable plans and procedures for land-use and area research in the southwest Pacific during the next two decades. It is merely a tentative suggestion.

REVIEWING EXISTING INFORMATION

As an inaugural and immediate step it seems highly desirable that existing information be collected together—information about the inherent physical properties of land, its current use, its suspected or proven possibilities, together with all economic and social data relevant to these themes. Some of this material has been worked over; some has not. It should be possible within two or three years for competent geographers to map available data and to present generalised reports within a chorological frame to accompany Wadham and Wood's mainly chronological survey and Belshaw's compartmentalised systematic statement. It would not be impossible to cull from a variety of sources and to correlate, on an island group basis, valuable

²⁶See F. M. Keesing: 'Extension Work in Pacific Islands', *Rural Sociology*, Vol. 9, No. 4, 1944, pp. 311-327; J. W. Coulter: 'Impact of War on South Sea Islands', *Geogr. Rev.*, Vol. 36, No. 3, 1946, pp. 409-419; K. B. Cumberland: 'The Basic Similarity of Agricultural Problems in the Southwest Pacific' [Fiji], *Agric. Journ.*, Vol. 19, 1948; and *idem*: 'New Zealand's "Pacific Island Neighbourhood": The Postwar Agricultural Prospect', *N.Z. Geographer*, Vol. 5, No. 1, 1949, pp. 1-18.

²⁷In Fiji, soil survey was inaugurated in 1947 and detailed geological field mapping was commenced in 1949. See L. E. Smythe: 'Soil Science in Fiji' [Fiji], *Agric. Journ.*, Vols. 18 and 19, 1947-1948.

information about land-use practices and problems in the dependent territories from New Guinea to the southern Cook Islands, and thus to prepare a third report. This would not be as complete and detailed a statement as those covering the dominions themselves, but would have possibly greater value because of the complete lack of any collated studies of the scattered areas in question. The completed trilogy would provide an admirable foundation upon which to base later detailed and particularised original field investigations. Field survey and mapping of land use and the interpretation of the data thus provided can only be a long-term project extending over a *minimum* of ten years.

NEW ZEALAND AND AUSTRALIA

With the cooperation of existing agencies, including the New Zealand Soil Bureau of the Department of Scientific and Industrial Research, the Soil Conservation and Rivers Control Council, the Department of Education, the four University Departments of Geography, the proposed New Zealand Social Science Research Council and the New Zealand Geographical Society, there is no reason why New Zealand should not, within a decade, have its own modern Domesday Book. It would be possible to organise through some central committee representative of these agencies and in liaison with the permanent headquarters of the World Land Use Survey, a project similar to that recently brought to a triumphant conclusion by the Land Utilisation Survey of Britain. This would involve the plotting of land use field by field for the whole country. There is a growing awareness of the value of and interest in land-use maps amongst several government departments, local bodies and regional planning agencies. There is a growing number of graduate students of geography prepared to do postgraduate work in the field. There are many enthusiastic teachers of geography, and third year students of geography, already doing annual field projects. The New Zealand Geographical Society has 1500 members many of whom would feel it a privilege to have a part in such a project as is here outlined. The basic fieldwork could thus be broadly shared, provided that a system of classification has been competently devised and that field notation procedures are simple and effective. The recorded fieldwork would have to be reduced to maps on a scale of 1 : 253,440 and this would mean a central draughting office and draughting staff. A Department of Geography in one of the four university colleges would probably prove a suitable central office. The fieldwork would be interpreted on a regional basis, and land use studied in relation to a wide range of physical and cultural factors by geographers of maturity and ability, working possibly towards doctorate degrees. Their work could then be published in, say, from ten to twenty regional reports which together would provide a dominion-wide coverage and an authoritative analysis and synthesis of New Zealand's land and its problems.

Australia presents greater problems as well as greater areas. The Commonwealth Government, however, is actively interested in exploring and developing the land-use potentialities of the continent. Its interest in these matters and the urgency with which it approaches the problems of exploiting the natural resources and of enlarging the cultural resources of its metropolitan and dependent Pacific territories appears much greater than is the case in New Zealand. The Commonwealth Scientific and

Industrial Research Organisation has already completed much land-use survey and done so on a more systematic basis than has been the case here. Although Australia has as yet only one university institution with a fully-fledged Department of Geography, the proposal to establish geographical research in the School of Pacific Studies in the new Australian National University of Canberra gives promise of rapid future development. The establishment of the School of Pacific Studies, equipped to conduct both specialist and cross-disciplinary research in the Pacific area, itself opens up the prospect of work on the economic, social and anthropologic aspects of land-use problems in New Guinea particularly. There appears to be no fundamental reason why, within the next generation, the utilised areas of the commonwealth should not be subject to the close technique of land-use survey required by the proposed world survey. The special physical characteristics and emptiness of the interior would present greater problems, if less urgent, and would require a somewhat different approach.

PACIFIC ISLAND TERRITORIES

There is an obvious field for research by geographers, anthropologists, agriculturalists and workers in the systematic biological and earth sciences in the dependent territories of the southwest Pacific. The survey and interpretation of contemporary land use must be an important cornerstone in any research programme for this vast region, and a cornerstone that should be laid very early in the erection of the building. This has been recognised by the South Pacific Commission by the inclusion in its research programme of surveys of land use in the New Hebrides (Efate) and of the restricted resources and the economic development of small coral islands in the Gilbert and Ellice Groups.²⁸

It seems clear that the School of Pacific Studies in the Australian National University will soon be operating research projects in New Guinea, Papua and possibly the Solomons. It will be ideally and adequately equipped to finance and man cooperative cross-disciplinary projects in those territories; and recent United States, British and Belgian experience of such joint research programmes would suggest that they might well produce significant contributions in relatively short time.

New Zealand has no School of Pacific Studies. At the moment there is little prospect of launching cooperative scientific research projects in the dominion's scattered dependent island territories. Although on a smaller areal scale, the Polynesian island territories in which New Zealand has direct interests—Western Samoa, the Tokelaus, Niue and the Northern and Southern Cook Islands—have strategic, economic, political and social problems no less significant to the dominion than are those of New Guinea to Australia. The roots of many of these problems lead down to the land. Improved utilisation of basic soil and water resources is a prerequisite to the solution of the more obvious but superimposed problems of health, diet, housing, transport, economics and politics. It could be argued that discussions of, and research into, general social and economic matters are rather groundless

²⁸See Appendix F to the *Proceedings of the Research Council* (of the South Pacific Commission), First Meeting: Economic Development, Noumea, 1949 (cyclostyled) and the *Proceedings of the South Pacific Commission*, Third Session, Wellington, 1949; and *ibid.*, Fourth Session, Wellington, 1950.

unless prior attention is paid to the improvement of land use and the conservation of land resources which must be the basis not only of ameliorative policies but of survival itself. About existing land-use practices there is, with a few exceptions, little precise information.²⁹ It would be no exaggeration to say that more information is available about the traditional (pre-European) agricultural practices of the southwest Pacific Polynesians than we have about the much modified and often deteriorated economies of today. Improved forms of land use, efficient and conservational—whether of a predominantly commercial or predominantly subsistence type—must be grafted on to contemporary practices. More precise information must be secured about land use today if land use is to be improved in future. Here lies an attractive opportunity for New Zealand geographers.

To undertake a comprehensive survey of cartographic recording of contemporary land use and agricultural practices in Rarotonga and adjacent raised coral islands of the southern Cook Group would not only be a fascinating research project for New Zealand geographers but would also serve important practical ends. It could be the basis for a better informed and more enlightened administrative programme and a contribution to the long term objectives of the South Pacific Commission. It would also be a valuable contribution to the World Land Use Survey, especially if it were considered a pilot project which would lead to the employment of improved methods and refined techniques in the survey of land use in other Pacific island territories and tropical dependent territories in other parts of the world.

It is not possible in a short paper to elaborate proposals such as these in detail. Details, in any case, come properly only after the suggestions have been discussed in their major aspects. That is the important thing at this juncture. It must be remembered that the opportunity for operating such projects is brighter than ever before, and that the need for area research, and especially land-use research, in the southwest Pacific was never more urgent.

²⁹See W. M. Hamilton and L. I. Grange: 'The Soils and Agriculture of Western Samoa', N.Z. Dept. Sci. & Ind. Res. Bull. No. 61, Wellington, 1938; J. W. Coulter: 'Land Utilization in American Samoa', B.P. Bishop Mus. Bull. No. 170, Honolulu, 1941; and A. C. S. Wright: 'Soil Reconnaissance of Niue Island', N.Z. Dept. Island Territories, Wellington, 1950 (cyclostyled).

RAILWAY TRANSPORT IN NEW ZEALAND

JAMES W. FOX

‘THERE can be no doubt that the railways are the backbone of the Dominion’s transport industry.’ With these words the Minister of Railways began a section of his annual report to the House of Representatives in 1950¹—but he could have gone even further and claimed that the railways are indispensable, for on the whole the roads of New Zealand cannot carry sustained heavy traffic nor transport passengers quickly over long distances. Nevertheless, to the average New Zealander railways do not seem as important as they do, say, to an Englishman. No great expresses thunder nonstop for hundreds of miles, no trains have histories that go back almost a century, and there is none of the appeal of American streamliners nor of European trans-continental trains with their coaches labelled with the names of famous capitals. New Zealand railways and trains lack glamour; they are prosaic, hardworking and rather grimy, and average speeds are low.

Nevertheless these very features provide a clue to some of the geographic characteristics of New Zealand. The Volcanic Plateau, the dissected hill country of Northland, Taranaki and Hawkes Bay, the plains of Canterbury and of the Waikato and Manawatu, the ranges of the Southern Alps, and the high country of Otago all present contrasting landscapes where the surface configuration has profoundly affected railway operation and development. The regional aspects of the sheep country of Hawkes Bay, of the dairy lands of the Waikato, and of forest in Westland are all reflected in the traffic originating in those parts; and in like manner, coal, lime, cement and specialised farm products figure prominently in the traffic returns for the areas devoted to their production.

Soft coal and fuel oil deposit on the cleanest of engines and rolling stock a thick layer of grime with which an attenuated labour force cannot adequately deal. White insulated vans for dairy produce and frozen meat, double-decked sheep trucks, and flat timber waggons constitute distinctive elements on New Zealand’s railways, just as much as in Great Britain fish vans are typical of east coast ports, and well, girder and plate waggons are ubiquitous in the heavy industrial areas

¹ ‘Railways Statement’, *Appen. Journ. House of Repres.*, (D-2), 1950, p. 2. This annual report contains a wealth of material and is invaluable as a reference.

of South Yorkshire, the Midlands and the Northeast. In short, to the national importance of railways so often emphasised there is to be added a regional significance not so readily apparent, but of equal interest to the geographer.

THE RAILWAY PATTERN

New Zealand in 1950 had open 3526 miles of railway owned by the government, 1683 miles in the North Island and 1843 in the South Island. In addition several miles of privately-owned track were in operation in the coalfields of the Waikato and western Southland,² and in the timber-milling areas of central North Island and the West Coast. One mile of railway thus serves, on an average, twenty-six square miles of territory and 780 people in the North Island, and thirty-one square miles and 340 people in the South Island—figures which emphasise the comparative emptiness of New Zealand and the great length of line in relation to possible traffic, and which contrast remarkably with those of Great Britain (four square miles and 2467 people respectively).

This characteristic of *length* as contrasted with *network* applies particularly to the pattern of railways in the South Island where the main trunk line runs from Picton to Invercargill, a distance of 584 miles. From this great artery, branches penetrate mainly westwards to the high country, some eventually to link up, as in Southland, and one to cross into Westland via the Otira Tunnel. Here, too, is found the remaining isolated stretch of railway line in New Zealand—that between Nelson and Glenhope. In the North Island the main trunk line traverses part of the central plateau, and consequently the railway pattern becomes more symmetrical than that south of Cook Strait. Short branches are no longer typical, for the lines to Gisborne, New Plymouth, Rotorua and Taneatua become main routes graced by express passenger trains. Moreover, the distance from Opua to Wellington, 626 miles, is greater than the corresponding section of the main trunk in the South Island, and when related to the lower total mileage in the North Island, emphasises again the diminished significance of purely branch lines north of Cook Strait.³

² The longest stretch of privately-owned line in coalfield areas is that of twelve miles between Birchwood and Wairio operated by the Ohai Railway Board.

³ The sections Picton-Invercargill and Opua-Wellington have been taken as representative main trunk lines since they are traversed by express passenger trains. Neither Invercargill nor Opua are the termini furthest from Picton or Wellington—these are Orawia and Okaihau respectively.

The railway pattern of New Zealand as a whole, then, owes much to past development when lines were built to link up existing areas of settlement and to open up the intervening country. Today the first of these functions remains significant although settlement and farming have now advanced far into the interior, and the major role of railways is to service these agricultural areas in terms of outward-bound produce and inward-moving fertiliser, cement, lime and other heavy goods. The second function no longer applies to the same degree, although lines are under construction or projected as part of forest-development schemes on the Volcanic Plateau.⁴ Projected connecting links such as those between Paeroa and Pokeno, and between Motuhora and Tancatua, in all probability may not be completed, since it is essentially the road which today opens up new country, functioning as a feeder to the railway. These links would render accessible no new areas of good farming country. Their main purpose would be to expedite traffic between Auckland, the Bay of Plenty and Hawkes Bay, thereby extending the influence of the dominion's major port; but it is questionable whether such development would be economically sound, even if construction costs could be met.

ROAD COMPETITION

Meanwhile the railways operate at a loss, and the decline of traffic in certain areas, particularly those served by branch lines, suggests that these lines must be closed or that rail and road traffic must be more efficiently coordinated. The Methven branch on the Canterbury Plains and the Dargaville-Donnelly's Crossing line in Northland are two examples where traffic is confined to a mixed train in each direction on weekdays, whilst on the Waiuku, Whitecliffs and Roxburgh branches, among others, freight traffic only is carried. Even on main lines road haulage competes successfully over distances up to one hundred miles from the main centres of population.⁵ The increased average length of haul per ton of freight from seventy-six to 103 miles between the years 1939 and 1950 reflects the tendency for railways to become a carrier of goods—and passengers—over relatively greater distances, while corresponding road services fulfil short-distance requirements or operate along more direct routes, as is the case with

⁴ These are respectively the Putaruru-Kinleith section, which is, in effect, a reconstructed timber railway, and the line from Edgecumbe to Murupara. Both lines will eventually facilitate the transport of timber, pulp and paper from the exotic forests to the ports and manufacturing centres, especially Auckland and Tauranga.

⁵ See 'Railways Statement', *op. cit.*, p. 10.

the Auckland-New Plymouth passenger traffic. In other words, rail transport today lacks flexibility.

This deficiency may be attributed in large part to past policies and to problems of terrain. Railway construction in New Zealand was initiated by the several provincial governments, but in 1870 became the responsibility of a central body. The existing broad gauges were abandoned in favour of one of three feet six inches, since it was appreciated that such a gauge would be more suitable for a national system with steep gradients and sharp curves over hill-country traverses. Moreover costs of construction would be more compatible with the potential national revenue.

OPERATING PROBLEMS

Today gauge limitations restrict maximum speeds to fifty miles an hour for steam locomotives and fifty-five for railcars, even in areas where severe gradients do not occur. The fastest runs take place along the Waikato and across the Canterbury Plains, and in the first area speedier operation is aided by double track between Auckland and Paerata and between Ohinewai and Frankton Junction (Hamilton).⁶ Here, as elsewhere, double track reflects a high density of traffic, so great in this case that the Paerata-Ohinewai section is at the present time being duplicated to relieve the congestion. To the same end, proposals have been put forward for the electrification of the North Island Main Trunk between Auckland and Frankton Junction, but it can be argued that steam locomotives operating over a double track would meet all possible traffic requirements since electric traction will not increase average speeds. Rather would it be more valuable to electrify the heavily-graded single track between Te Kuiti and Marton which carries a dense volume of traffic over difficult country, and where the double-heading of heavy trains often becomes necessary. As a regular practice double-heading prevails on such stretches as the twenty-eight miles between Dunedin and Oamaru, but elsewhere remains as an alternative to the breaking-down of the train load. Between Te Kuiti and National Park, too, some trains must have the assistance of a second locomotive, and thereby running costs are correspondingly increased.

In fact it may be claimed that the North Island Main Trunk between

⁶ Double track comprises but four percent of the total route-mileage in the dominion. In addition to those noted, the most important sections lie between Wellington and the suburban points of Tawa Flat, Lower Hutt and Taita; between Heathcote and Rolleston in the Christchurch area; and at Dunedin between Sawyers Bay and Mosgiel.

Te Kuiti and Marton is an epitome of New Zealand railway engineering and operation. The gradients and curves, the bridges and tunnels, and above all, the Raurimu Spiral, are tributes to engineering skill; the traffic is mainly through traffic, with local additions of timber from Mangapehi, Taumarunui and National Park, of sheep from Taihape, and of ski-ing enthusiasts and tourists from National Park; and train-running costs per mile rank higher than in any other section in the country, primarily because the typical engines working in this area are of the heavy oil-burning, eight-coupled J and K classes, themselves triumphs of New Zealand locomotive engineering.

CROSSING RIVERS AND MOUNTAINS

Some of these characteristics are repeated in other areas, but also fresh problems arise. In the hill country of the eastern North Island, near Wairoa, the highest viaduct in the dominion, 315 feet high and 913 feet long, spans the Mohaka River; whilst in the South Island the lengthy bridges across the braided courses of the Waimakariri, Rakaia, Rangitata and Waitaki demonstrate that railway construction across the Canterbury Plains had its difficulties too. The crossing of mountain barriers adds further regional aspects to the geography of New Zealand railways, particularly the Otira Tunnel, five miles and twenty-five chains long, operated by electric traction, and the Rimutaka Incline between the Summit and Cross Creek, a distance of three miles with a ruling gradient of one in fifteen. Special Fell locomotives and brakevans operate over this section, using a third rail for adhesion and braking purposes. Opened in 1878, this system has served the Wairarapa well, but today too much time is spent in shunting and marshalling trains with locomotives and brakevans at the stipulated intervals. Passenger needs are now met by special railcars with a high ground clearance to avoid the third rail, and preliminary work has commenced on a deviation tunnel through the Rimutaka Range.

Finally, mention must be made of some of the natural hazards which affect railway working in New Zealand. Floods are not rare in the hill country of Hawkes Bay, Taranaki, Marlborough and Canterbury. Lines have been blocked by slips or washed out entirely, as, for example, at Kai Iwi between Patea and Wanganui in 1949, and recently at Kowai, on the Christchurch-Greymouth line, where a bridge was swept away by floodwaters. The peat swamps of the Waikato pose their problems too, witness the regulation that 'owing to danger of

track without passengers must be allowed to remain stationary on the siding at Rukuhia for any length of time.'

These diverse elements of the surface configuration thus provide a natural background to the character of the dominion's railway transport system, but in their turn these regional aspects are modified by a distinctive local differentiation in traffic, particularly with respect to the areas in which certain types originate.

TRAFFIC IN ITS REGIONAL SETTING

Obviously there exists a major distinction between the two islands. Almost two-thirds of the total traffic revenue comes from the North Island, where there is also a slightly greater emphasis on the carriage of passengers, but not so great as one might expect in view of the fact that the North Island is the home of two-thirds of New Zealand's population. The North Island Main Trunk carries forty percent of the total rail traffic in the country, and carries percent more than the total for the South Island. As far as the North Island itself is concerned, more than two-thirds of the total traffic and thereby dominates the operations of the agricultural land traversed and the overwhelming importance of the metropolitan area of Auckland and Wellington as centres of population, of manufacturing and of commerce.

In terms of weight, one-quarter of the goods traffic conveyed by rail in New Zealand is classed as miscellaneous. Bulking as large is the transport of such the average load of brown coal being 418 mds.—a reflection of the peripheral location of centres of population and the nature of nature of the main fields in the Westland, the northern King Country and western Southland. On the other hand, bituminous coal from Westland travels seventy-five miles, most of it moving from the mine to the nearby rail-dipping point at Greyhound and Westport, and through the Otira Tunnel to Christchurch. Timber is culled from west Southland, Westland and the interior of the North Island from Canterbury, Marlborough, Eastland, Tairāhema and National Park in particular, over an average distance of more than 150 miles, chiefly to the four chief cities, and, interestingly enough, to Tauranga where it now develops as a port-dependent export route with-
out from the Victoria Plains. The traffic of brother coals is in a opposite direction, from the port area where it is manufactured (the interior farmlands) the average haul being one hundred miles.

The distribution of oil and petrol shows similar characteristics. Products of cement works, market gardens and fishing ports also range widely, but frozen meat travels only forty miles since most freezing works are conveniently located near the ports.

The traffic most characteristic of New Zealand is probably that associated with the movement of stock, dairy produce and meat, and here again arise distinctions between the two islands and between agricultural regions within each. The movement of cattle and calves in the South Island ranks insignificantly when compared with that through centres such as Morrinsville, Matamata, Dargaville, Te Awamutu and Matawhero. Relatively the carriage of sheep becomes more important in the south, although much of the traffic has been lost to the road, especially in Otago and Southland. Nevertheless in the North Island are to be found three times as many sheep-despatching centres where traffic figures rank as high or higher than those of Blenheim, Kaikoura, Culverden, Little River and Gore. Store sheep from the hill country of Taranaki, Hawkes Bay and East Cape combine with fat lambs from Northland, the Waikato, Bay of Plenty and Manawatu to provide more than sixty percent of the total sheep traffic carried on New Zealand railways.

SUBURBAN FEATURES

Manufactured goods do not figure separately in the published railway returns, but in the vicinity of Auckland, Wellington and Christchurch freight trains haul their quota of assembled cars, tractors, electrical gear, textiles, clothing and foodstuffs. Suburban lines, with their additional passenger trains, accordingly carry more than ordinary densities of traffic. Congestion becomes serious unless the track is doubled or is electrified and operated through a centralised train control. Even so, it has become necessary to commence work on the electrification of the Hutt Valley suburban lines, and a recommendation has been made for similar development in the Auckland suburban area between Henderson and Papakura.

Meanwhile multiple-unit train sets meet suburban demands on the electrified sections between Wellington and Paekakariki and between Wellington and Johnsonville. From Wellington to stations in the Hutt Valley, and in the Auckland suburban area, trains are headed by steam locomotives, typically tank-engines because of the facility with which they handle this type of traffic. Suburban passenger traffic in the Wellington area, to judge by the number of season tickets sold, ranks

as the highest in New Zealand, being six times greater than that in either Auckland or Christchurch. Suburban passengers to and from Auckland have shown some decline in numbers over the past five years because road services are more frequent and more convenient.

It has been argued that the solution to railway operating problems in New Zealand lies in complete electrification. The existing sections through the Otira Tunnel, between Lyttelton and Christchurch, and in the Wellington area, comprise less than two percent of the total route-mileage. Justification for this argument lies in the fact that the dominion's annual coal output of two million tons provides insufficient for railway needs and that most of the coal mined is of poor steaming quality. Imported coal and oil have been used in recent years to eke out these meagre supplies, but at great expense.⁷ On the other hand, hydroelectricity could supply all the power needed, but resources are not fully developed. Electrification of the railways and hydroelectric power development thus go hand-in-hand, and both require an expenditure of capital so enormous in relation to the present population of the country that the schemes must be both piecemeal and long-delayed.

FUTURE DEVELOPMENTS

Nevertheless it is appreciated that traffic, in terms of gross ton-mileage, will increase by fifty percent during the next ten years, and that some preparations must be made in anticipation.⁸ But the function of the railways will hardly change. The main line between Auckland and Wellington will continue to be a great artery carrying the life-blood of a dominantly pastoral country—fertiliser, lime, cement and manufactured goods inwards; and outwards, livestock, meat and dairy produce. Branch lines may be closed as road transport becomes complementary rather than competitive; the major part of railway revenue may always come from the North Island; there may be changes in some aspects of the country's economy; but always there will remain regional characteristics in railway traffic and regional problems in railway operation. Yet one day the last steam locomotive will head a train, maybe on the North Island Main Trunk, more probably somewhere in the South Island, and with its passing the magnificence of steam power will depart from New Zealand's railways.

⁷ During 1950 the railways used 527,882 tons of coal, fifty-five percent of which was 'soft' coal and thirty-three percent bituminous. The remainder was imported. Fuel oil consumed in the same period amounted to almost twenty million gallons. Oil-burning locomotives now account for approximately one third of steam-train mileage run.

⁸ 'Railways Statement', *op. cit.*, p. 2.

PHOTOGEOGRAPHY

A PICTORIAL SURVEY OF NEW ZEALAND

8. RAILWAYS : ARTERIES OF STEEL

Fig. 1. Running Free into Raurimu. From Okaihau to Bluff, from inland height to coastal plain, railways serve New Zealand. Symbolic of this service, a typical mixed train, loaded with sawn timber, logs and a few passengers, rounds the bend at the foot of the famous spiral



All photos: New Zealand Government Railways



Fig. 2. *Fast Run to Frankton. Double track is the exception in New Zealand, and sections such as this near Taupiri become galloping-grounds for Auckland-Wellington expresses.*

DOUBLE TRACK AND DOUBLE-HEADING

Fig. 3. *Difficult Haul to Oamaru. Steep gradients and sharp curves over broken country between Dunedin and Oamaru make the double-heading of expresses a necessity.*





Fig. 4. *High Plateau.*
The Daylight Limited
passes Waiouru (2,670
feet)—the highest point
on the North Island
Main Trunk.



Fig. 5. *Plain.*
A local train on the
Methven branch amble
across the Canterbury
Plains.



Fig. 6. *Hill Country.*
Between Stratford and
Okahukura a mixed
train climbs slowly
through the Tangaraka
Gorge.

Fig. 7. North Island
valleys. The
Tupua-niwhemua Viaduct
near Ohakune straddles
stream 149 feet below.



Fig. 8. South Island
rivers. A new bridge,
miles long, spans the
winding course of the
Kaitiaki.



Fig. 9. Unstable
country. The track is
aligned after an
eight-yard slip into the
valley of the Kai Iwi
Sum, Taranaki.





A northbound freight train near Otaki hauls coal, electrical gear and miscellaneous goods.

Passengers are carried over the Rimutakas in railcars; Fell locomotives still deal with goods traffic.



On electrified sections near Wellington multiple units, not steam-trains, handle suburban passenger traffic.

Figs. 13, 14 and 15.

STATION AND TERMINUS

Freight trains pass
through suburban
Petone in the Hutt
Valley industrial area.



*Taihape with its
loading-pens, and
timber, petrol and stock
waggons symbolises
interior North Island.*

aving Wellington,
e Tawa Flat deviation
sses the road and
ilway to the Hutt
alley.



NEW ZEALAND GEOGRAPHICAL SOCIETY: BRANCH AFFAIRS

CANTERBURY BRANCH

OFFICERS for 1951 are— *President:* Mr. J. L. Hewland
Vice-Presidents: Dr. G. Jobberns, Dr. P. R. Woodhouse, Mr. H. M. Sweney
Chairman: Mr. A. C. Pitcaithly
Hon. Secretary-Treasurer: Miss J. Chapman *Hon. Auditor:* Mr. W. Rosenberg
Committee: Miss M. Caine, Dr. G. Uttley, Mr. M. McCaskill,
Mr. A. V. Barley, Mr. J. K. Cunningham

The 1951 session opened with the March meeting at which Mr. J. L. Hewland delivered his presidential address 'European and Canterbury Plains: Some Contrasts'. In April, Mr. R. B. Lamb, Visiting Lecturer from the University of California, Los Angeles, gave an illustrated talk on the 'Yosemite Valley and Toulumne Meadows of the High Sierras'. In May branch activities were overshadowed by the Seventh New Zealand Science Congress held in Christchurch during that month. The annual general meeting of the New Zealand Geographical Society was held in June and was addressed by Professor Weststrate, Professor of Economics at Canterbury University College, on 'The Clash between Two Economic Systems in Southeast Asia'. At the July meeting Mr. H. W. Gaudin, Director of Education in the Solomon Islands, gave a talk on the islands and their people.

During the year the branch welcomed back a distinguished member, Mr. W. P. Packard, who spent a brief vacation in New Zealand before returning to England in June to take up a lectureship at University College, London. To a large public gathering Mr. Packard described his recent Himalayan experiences, illustrating his talk with coloured slides.

WELLINGTON BRANCH

OFFICERS for 1951 are— *President:* Dr. R. A. Falla
Vice-Presidents: Mr. C. G. Bloore, Mr. N. E. Dalmer, Mr. D. I. MacDonald,
Mr. A. Mulgan, Mr. R. J. Waghorn
Chairman: Mrs. J. K. Bewley
Secretary: Mr. G. D. Anderson *Treasurer:* Miss B. Page
Hon. Auditor: Mr. T. L. James
Committee: Mrs. S. S. Turner, Mr. C. A. Fredericksen, Mr. W. M. Jones,
Mr. J. McWilliams, Mr. A. J. Sligo

The return to our established regular meeting night—the third Wednesday—has been one factor which has contributed to good attendances at monthly meetings of the branch. However, the lack of sustained interest on the part of both students and student teachers is causing the committee much concern.

With the exception of the talk by Miss Olive Wright on her research into the D'Urville manuscripts, the meetings have been addressed by people with an intimate knowledge of the overseas countries they lectured on, and have been particularly valuable in stimulating discussions on problems of current interest.

The branch is looking forward to the opportunity to extend to Professor Cotton its congratulations on the award to him of the Royal Geographical Society's Victoria Medal for his work on the geomorphology of New Zealand. The presentation will be made by the Hon. C. M. Bowden at the meeting of the branch on 15 August 1951.

AUCKLAND BRANCH

OFFICERS for 1951 are— *President*: Mr. L. V. Bryant

Vice-Presidents: Dr. Gilbert Archey, Sir Albert Ellis, Professor V. J. Chapman,
Professor W. R. McGregor, Dr. E. P. Neale, Mr. L. K. Munro

Chairman: Mr. L. Lucena

Deputy-Chairman: Mr. A. R. Harvey

Hon. Secretary: Mr. R. G. Lister *Hon. Treasurer*: Mr. W. B. Johnston

Hon. Auditor: Mr. J. K. Bedbrook

Committee: Miss B. M. Williamson, Mr. F. Richardson, Mr. N. Whatman

The programme of monthly lectures has been augmented this year by several evenings when films (or slides) have been shown, notably by Mr. Maurice Brown, who showed some superb coloured slides and films made on his tour in 1949 through Spain; and by Mr. W. P. Packard, whose series of colour shots of the 1950 expedition to the Himalayas delighted a large audience.

Two excursions were organised, the first in March to vineyards and orchards at Henderson, and the second, conducted by the Auckland City Waterworks Engineer, to view the installations and dams in the Waitakere Hills.

Lectures were presented as follows—March: 'With UNICEF in China, Siam and the Philippines', Miss E. H. Moyle; April: 'Agricultural Reclamation in Walcheren and the Zuider Zee', Dr. Bruin; May: 'The Cook Islands', Mr. W. B. Johnston; June: 'Luxembourg, and its Place in Western Europe', Professor K. C. Edwards; July: 'Auckland City Water Supply', Mr. A. D. Mead; August: 'The Place of Geography in New Zealand Education', Mr. L. V. Bryant; September: Honours Students' Evening; whilst in October Dr. Geddes of the Anthropology Department Auckland University College, gave an illustrated lecture on his experiences in Borneo.

OTAGO BRANCH

OFFICERS for 1951 are— *President*: Mr. A. H. Payne

Past President: Mr. B. J. Garnier

Vice-Presidents: Mr. P. G. Connolly, M.P., Mr. G. Simpson, Mr. H. I. Sinclair.

Chairman: Mr. W. E. Earnshaw

Hon. Secretary-Treasurer: Mr. A. D. Tweedie *Hon. Auditor*: Mr. G. S. Kirby

Committee: Miss J. E. Bisset, Miss E. L. Elliott, Miss S. Hay, Mr. J. C. Begg,
Mr. J. Finkelstein, Mr. J. U. Macaulay, Mr. D. Sage

At the annual general meeting for 1951 the President, Mr. A. H. Payne, delivered a presidential address on 'Some Aspects of the Geography of Pakistan'. In April Mr. F. L. Sanderson, of the Otago School of Mines, analysed the geographic background of the present disturbances in Malaya. Those present at the May meeting were fortunate to hear Professor K. C. Edwards, of the University of Nottingham, speak on the Grand Duchy of Luxembourg. In June Mr. A. D. Tweedie introduced a controversial topic by drawing attention to the geographic basis for planning in the Metropolitan Dunedin area—a talk that was followed by spirited contributions from local body representatives present.

The branch welcomes the news of the appointment of Mr. R. G. Lister of Auckland to the position of Head of the Department of Geography, University of Otago, and is looking forward to his active support.

GEOGRAPHIC NOTEBOOK

CONTRIBUTORS TO THIS ISSUE. The four main articles in this number of the *New Zealand Geographer* have been written by three geographers, all at Auckland University College, and a geomorphologist, Professor C. A. Cotton, of Victoria University College, Wellington. Professor Cotton's work is well known, not only in New Zealand, but also throughout the world. So valuable indeed have been his contributions to the field of geomorphology that the Royal Geographical Society this year awarded him the Victoria Medal. Professor Cotton has in many ways encouraged the development of geography in this country, and accordingly the New Zealand Geographical Society welcomed the privilege of presenting the medal on behalf of the Royal Geographical Society. The presentation was made by the Hon. C. M. Bowden at a meeting of the Wellington Branch on 15 August 1951.

Sixty-seven years ago Dr. Julius von Haast received the Patron's Medal of the Royal Geographical Society in recognition of his work in the Southern Alps. Dr. C. A. Cotton now follows in the same tradition, and just as the election of Dr. von Haast stimulated scientific research in New Zealand, so will that of Professor Cotton. Geographers in this country congratulate Professor Cotton and acknowledge their debt to him.

Of the remaining articles, that of Mr. W. B. Johnston represents a record of one aspect of fieldwork undertaken in New Zealand's Pacific dependencies during the latter part of 1950. Dr. Kenneth B. Cumberland paints a broader canvas, but the work of both emphasises that much research in land-use problems has yet to be carried out, or even initiated. Dr. Cumberland's suggestions are worthy of consideration by all who have any interest in the future of the territories of the southwest Pacific, no matter whether they be administrators, technical advisers, or laymen.

Photogeography in this number deals with railway transport in New Zealand. The geography of transport has been accorded little attention in New Zealand, but in his accompanying article Mr. James W. Fox presents a survey of some of the geographic characteristics of railway operation and traffic movement as a preliminary to further research.

Finally, the notes, commentaries and reviews have been contributed by Professor G. Jobberns, Mr. Murray McCaskill, Miss June Chapman and Mr. Owen Brown of Canterbury University College; Professor K. C. Edwards, Professor V. J. Chapman and Mr. A. L. Odell of Auckland University College; Dr. R. A. Falla, Director of the Dominion Museum; Mr. J. T. Holloway, New Zealand Forest Service, Christchurch; Mrs. J. K. Bewley, formerly Junior Lecturer in Geography at Victoria University College; Mr. Arthur Haley of Horowhenua College; and the editorial staff.

GEOGRAPHY AT THE BRITISH ASSOCIATION. At the inaugural meeting of the British Association for the Advancement of Science held at Edinburgh on 8 August 1951 the president, H.R.H. the Duke of Edinburgh, spoke of the British contribution to science and technology in the past hundred years, and thereby emphasised that several sections of the association were holding centenary sessions. Among these was Section E (Geography), which was accorded the signal honour of the president himself opening the section proceedings. The pertinent remarks made by

His Royal Highness on that occasion will be of interest to all geographers, but more especially to members of the New Zealand Geographical Society in view of the forthcoming, eagerly-anticipated visit of the Princess Elizabeth and the Duke of Edinburgh to this country in 1952.

After declaring the session open, His Royal Highness went on to say: 'Geography includes within its scope some subjects connected with my own profession, such subjects as hydrography, navigation, survey and weather conditions which are branches from the main stem. During the past century the section has had among its presidents and other speakers many who were eminent in these subjects, but in that time the professional geographers, and especially those men and women who teach the subject in our schools and universities, have greatly increased in number, and it is they who set the pace, so to speak, for the diffusion of geographical knowledge through *all* its branches. This is perhaps the biggest achievement of geography during the past hundred years.

'There are many people who think that geography has not yet taken the full place it deserves in education, and there are good grounds for that: because, to know as much as we can about the world and its peoples is more of a man's duty today than it was a hundred years ago. The nations of the world were not then in such close and direct contact as they are now, or can be if they will. The more they get to know about each other the better it must be in the long run. For, after all, getting to know about each other *is* geography; that seems to me to be a plausible definition of your subject.'

SEVENTH NEW ZEALAND SCIENCE CONGRESS. More than 500 people attended the Seventh Science Congress of the Royal Society of New Zealand held in Christchurch in May 1951. This was the first occasion on which a full programme has been provided for a geography section at a science congress in this country. Fourteen papers, arranged in three symposia, were presented in the Geography Section and more than forty people attended the sessions.

More than two-thirds of New Zealand's population live in towns and cities and the six papers contributed to the symposium *Urban Geography* show that geographers are aware of the importance and opportunities in this field of research. In his chairman's address Mr. L. L. Pownall defined the aim of urban geography as the description and interpretation of the character of towns as distinctive entities on the earth's surface. He outlined the methods used in such studies by some New Zealand geographers and thereby emphasised an aspect of research not previously reported on. One of the few overseas visitors to the congress, Professor K. C. Edwards of the University of Nottingham, gave an account of the geography of some new industrial towns in England, illustrated with special reference to Corby, a new steel-making centre in the Midlands. Mr. A. D. Tweedie of the University of Otago dealt with the concept of the Metropolitan Area with special reference to Dunedin and its adjacent countryside. Mr. Tweedie emphasised that boundaries of many local government authorities are merely arbitrary divisions cutting across areas that are linked together in their daily economic and social life.

Three papers were given by workers in the field of town planning. Mr. John

Cox spoke of 'Geography and Planning'. He reviewed what has been accomplished in town and regional planning in recent years, discussed current problems and made some challenging suggestions as to the ways in which New Zealand geographers could assist in the solution of practical problems of town and regional development. Miss Nancy Northcroft discussed the principles and possibilities of the urban green belt and made a plea for the geographer to assist the planner in the task of delineating the green belt upon the ground. A statement on the scope and methods of urban surveys in the field of town planning was prepared by Mr. T. S. Johnson.

The symposium *Geography and Land Use* was introduced by Miss Eileen Elliott who spoke on the application of a rapid and standardised form of survey to urban and rural areas under the Town and Country Planning Acts in Britain. Mr. James W. Fox, of Auckland University College, outlined a scheme for a standardised rural land-use survey of New Zealand and displayed large-scale maps of areas in the Auckland Province where the scheme had been applied. Following discussion from the floor, the Geography Section of the congress recommended that the Council of the New Zealand Geographical Society consider the sponsorship and preparation of such a survey for the whole of New Zealand.

An account of a land-use survey of the Heretaunga Plains carried out in response to the urgent needs of a local authority was presented by Mr. R. W. S. Fargher of Hastings High School. Through the voluntary efforts of a group of citizens a survey was made of land use in an area of 120 square miles where the urban sprawl of Napier and Hastings threatens to engulf some of the most highly productive farm land in New Zealand. An account of some aspects of land use on Rarotonga, one of New Zealand's little-known Pacific island dependencies, was given by Mr. W. B. Johnston of Auckland University College.

A problem often confronting geographers in the interpretation of areas of low relief is that of securing a suitable vantage point from which to study landscape features in their broader associations. Mr. R. B. Lamb, Visiting Lecturer from the University of California, discussed the use of the 35 m.m. camera and the small aeroplane in geographic fieldwork. His superb series of colour slides of Texas and the Canterbury Plains showed the immense advantage of the low-altitude, aerial-oblique photograph over the 'fence-post' variety with which most geographers have hitherto been content. Colour patterns revealed on the Canterbury photographs suggest that the extent and incidence of sheet wash and wind erosion on the Canterbury plains may have been greater than some observers on the ground have been led to suspect.

The symposium *Geography in Education* stimulated considerable interest and discussion. Mr. J. Martin's evaluation of the results being achieved in the teaching of geography in primary schools will appear, it is hoped, in a forthcoming number of the *New Zealand Geographer*. Results of a statistical survey into the use of geographical fieldwork in New Zealand secondary schools were discussed by Mr. L. J. Kearney and Mr. N. H. Whatman of Ardmore Teachers' College. They concluded that while there is general agreement among teachers that fieldwork is vital to the study of geography, there is a totally inadequate application of it in our secondary schools. An abstract of this paper will be published in the *Record*. Several aspects of sixth-

form geography were discussed by Mr. J. L. Hewland of Christchurch Boys' High School. The aim of teaching at this level should be to provide the student with a sound body of up-to-date knowledge, to develop an ability to form and express conclusions in clear language, and to stimulate an enthusiasm to add to that knowledge and to skill in handling it. The speaker considered that the scope of the Entrance Scholarship examination is too wide and that the system of scaling marks tends to penalise the student offering geography.

In addition to their sectional programme, geographers found much material of interest in the papers presented in the Agriculture, Forestry and Soil Sciences Sections, while there were significant contributions to several branches of systematic geography in the symposia in Geology, Ecology and Meteorology.—M. McCASKILL

AN EARLY GEOGRAPHY OF NEW ZEALAND. A small geography primer recently placed in the library of the New Zealand Geographical Society must be one of the earliest treatments of the subject to be published in New Zealand. Written by D. Petrie, M.A., with the title *Geography of New Zealand and the Australian Colonies* it appeared in 1878, one year after education was made free and compulsory. It illustrates in a striking manner the conception of geography as a teaching subject commonly held some seventy years ago.

The author, who was a Scot educated at the University of Aberdeen, was appointed inspector of schools in Otago in 1874 after a period of teaching in Melbourne. In 1894 he became chief inspector to the Auckland Education Board and later served as president of the Auckland Museum and Institute. In the academic field he is chiefly remembered for his botanical writings and in particular for his work on the flora of New Zealand. In his little *Geography* nearly sixty pages are devoted to New Zealand, sixteen to Australia and Tasmania (then a separate colony), after which comes a brief appendix giving population and trade statistics for the first-named country.

The text is typical of the period, arid in substance, unimaginative in approach, and without a single map or picture. Admittedly the author hoped that a companion atlas would later be issued, but it is doubtful if this ever appeared. The majority of the pages contain little more than lists of features of coasts, mountains, rivers, lakes and towns, with their names in heavy type (presumably to be memorised) and arranged neither in order from north to south or in strict succession around the coasts. While the principal physical features of the country are thus catalogued there is no attempt to relate them to their human significance and use, although several of the rivers are crudely described as having basins which are highly auriferous! Climate, which has had such great influence on New Zealand's landscape and human economy, is dealt with towards the end rather as a curiosity, along with sections on the Maori, the fauna and flora, and the discovery and history of the country.

The remarks on the flora, in explanation of which the land bridge theory is inferred, are pertinent. Writing only thirty or forty years after the beginnings of systematic colonisation, the author notes how imported grasses, clovers and other species were fast supplanting the native herbaceous plants and how the destruction of the bush encouraged the spread of exotic trees: 'As they [the forests] seldom

grow up again, we may expect to find the native timber trees gradually replaced by Australian gums and European and American pines.' The descriptive notes on each provincial district are generally informative and give some idea of the stage of development reached and of the prevailing economic activity, but reveal little of the true geographic character of these units or of distinctive areas within them.

A perusal of this small book raises many points of interest. For instance the population figures are based on the census of 1874, the first to be taken after that of 1861 and containing the first of the regular sequence of separate totals for the Maori population, which at this date numbered 45,470. It depicts moreover an unparalleled growth in the settlement of the country following the gold rushes. Actually between 1861 and 1874 the European population grew from 99,000 to 299,500 and by 1878 reached 414,400. In 1874 alone the increase was nearly 46,000 including 32,000 assisted immigrants, a figure which has never been exceeded. At this time more than sixty-two percent of the inhabitants were in the South Island, the reverse of today, with Dunedin (27,000) the largest town. Auckland was about the size of one of its present-day suburbs, Mt. Eden or Mt. Albert, while after the four main centres Thames ranked next with 8000 people. This period of swift and prodigious expansion which transformed much of the New Zealand landscape, does not appear to warrant geographical comment, however, apart from the reference to vegetation already quoted.

Equally interesting are the references to contemporary developments, some of which have not met with the success predicted for them. Thus Foxton, described as a seaport and railway terminus, was regarded as the chief potential outlet for Palmerston North. In Taranaki, the development of dairying not being envisaged, fruit-growing and industrial activity (the N.Z. Iron and Steel Co. having just erected blast-furnaces for treating the iron-bearing sands) appeared to offer the highest prospects for the future. Another trend, not lacking altogether in fulfilment, was the growing importance of hops and vines around Hawkes Bay and the production of fine quality wool which promised to make that area a leading one for sheep, more particularly as 'the breeding ground of New Zealand'.

Compared with modern textbooks or with the excellent post-primary school bulletins prepared by university geographers for the schools of today, Petrie's contribution, though doubtless useful in its day, is now almost a pedagogical curiosity. It is an interesting relic of the educational outlook of a past era. As an exposition of geography it scarcely even represents a datum line, as did J. R. Macdonald's elementary book published in 1903 and P. Marshall's more substantial *Geography of New Zealand* two years later, both of which indicated a formative stage in the development of the subject.—K. C. EDWARDS

INTERNATIONAL RESOURCES CONFERENCE. In August and September 1949 the United Nations sponsored and arranged a Scientific Conference on the Conservation and Utilization of Resources (UNSCCUR). At a time when high living standards, rapidly advancing technology, expanding industries, war and armaments are consuming the world's available resources at an unprecedented rate, it was appropriate that the United Nations should call together scientists from all

parts of the world to review the resources of the nations and to calculate the prospects of conserving them and of avoiding their exhaustion. If only because of the limited resources with which the country is endowed and the wastage hitherto involved in the exploitation of its soil, the one resource above all upon which its economy is founded, New Zealand should have been interested in contributing to the discussions, in being adequately represented and in reading the conference reports.

The first volume of a series of seven reports reached New Zealand in December 1950 (*Proceedings of the United Nations Scientific Conference on the Conservation and Utilization of Resources*; Vol. I, Plenary Meetings). It is the most important. In it are published the papers read at the plenary session by outstanding world authorities in their fields. These papers include reviews of the general resource situation (Colin Clark's 'World Resources and World Population' is a remarkably thoughtful and suggestive contribution), of critical shortages (especially of food), of soil and forest resources (including authoritative statements by H. H. Bennett and R. M. Salter), of fuels and energy (Sir Harold Hartley and L. Jacqué), and of metals and minerals.

This first report also includes a list of scientists attending the conference and/or presenting papers. It is of some interest to record that three representatives of New Zealand were present and that thirteen presented papers. This representation was not adequate in comparison with that of the United Kingdom (thirty-two and seventy-eight respectively) and with that of even the small European nations. But on closer inspection its inadequacy becomes greater because of the fact that New Zealand contributors and participants alike were all present or retired members of government departments and government research organisations. No other national delegation was weighted in this way; all were adequately representative not only of government scientific agencies, but also of the universities, private research institutions and commercial organisations.

It seems a pity, too, that New Zealand's one contribution to the plenary session should have been a background paper in the form of a pedestrian and purely factual account of the number and title and price of film strips available in New Zealand for soil conservation education, the number of screenings of films by a mobile cinema unit, and the number of farmers and school children present. It was a comprehensive and carefully tabulated report on what has been done but provided nothing new, came to no conclusions and made no suggestions. In this report 'scientific papers' as educational material were given but three and a half short lines. It would surely have been more appropriate to have made it possible for some such authority as Mr. Bruce Levy to have addressed the plenary session and thus to have enabled New Zealand to make a real contribution to, say, the session on 'Creatable Resources: The Development of New Resources by Applied Technology'.

WORTHY OF HIS HIRE. Through the departments of geography in the four constituent colleges of the University of New Zealand pass every year some 750 students at all stages, approximately fifty completing their third stage towards a bachelor's degree, and from ten to fifteen attaining full stature as Masters of Arts or Masters of Science. Most of these students are destined for, or are members of, the teaching profession, and the dearth of fully-qualified and competent teachers of geo-

graphy means that this trend will continue for some time to come. Yet there are students who do not wish to teach, for good teachers are born and not fashioned in Training Colleges, and, moreover, there are those whose talents would be wasted in the classroom. But in New Zealand young fully-trained geographers can find few openings other than in the pedagogical sphere, and consequently they become lost to scientific research. Blame for this must lie with authorities who do not appreciate the worth of geographical training, or if they do, prefer that research should be undertaken by systematic scientists with particularised viewpoints. (It must be pointed out here that 'geographical training' implies *at least* the completion of a three-year course.)

Geographers in Britain do not experience these restrictions to the same degree. The significance of geography as an integrating, interpretative science has not been lost upon those responsible for planning in the various government departments, nor upon officers in charge of intelligence at the Admiralty, War Office and Air Ministry. Industry and commerce have also called upon the services of the geographer.

Similarly in the United States recognition is made of the valuable contribution of the geographer to the accurate compilation, presentation and interpretation of data fundamental to the solution of problems local, national and international in scope. A recent *Announcement* by the United States Civil Service Commission points out that geographers are required by the Bureau of Census and by the Departments of Commerce, the Interior, the Navy, the Army, the Air Force and Defence to 'direct, perform, or assist in performing professional work in the field of geography'. This field is defined in terms of regional and urban geography, industrial and commercial geography, physical geography, land use and land capability, place names and resources. But perhaps the most significant statement of all is that one of the duties of the geographer will be 'to coordinate non-geographical subject fields with the geographical programme of a particular agency'. As rewards for their labours these geographers command basic entrance salaries which range from \$3825 to \$10,000 (£1365 to £3570) a year, grading being dependent on academic achievement and professional experience.

New Zealand today claims recognition as a Pacific Power. Such pretensions imply that concomitant responsibilities are understood and accepted. If this dominion is to play its full and proper part in its regional sphere, just as Britain and the United States are doing in world affairs, then it too must recognise the value of geographical training. Compartmentalised knowledge provides a first and necessary step to the solution of problems. Integration in terms of area must, however, follow, and that is the *métier* of the geographer.

OBITUARY. Patrick Marshall died on 10 November 1950 in his eighty-second year. With his death there passed from the ranks of New Zealand scientists a man respected by all for the breadth and depth of his knowledge in the systematic sciences, for the contributions he made to those fields, and, above all, for that humility and humanity which are the hallmarks of a truly great man.

His career was as distinguished as it was varied. As a school teacher, university teacher and consultative geologist his interests ranged widely; and although his entomological studies represent valuable contributions to natural science in New

Zealand, it is for his work in geology that he is best known. Papers on igneous rocks, fossils, stratigraphy, coral reefs, beach sands, glaciation and a host of other topics flowed from his able pen, and along with them, Geological Survey Bulletins and other books. Professor Marshall gained world-wide recognition for his work on the geology of the southwest Pacific and it was after him that the Marshall Line was named. In New Zealand it was he who proposed the name 'ignimbrite' for the tephritic welded tuff so characteristic of the Volcanic Plateaus.

In the realm of geography Marshall made a significant contribution with his *Geography of New Zealand* published in 1906 and revised in 1911. As is to be expected, the approach was essentially systematic, with an emphasis on physical geography, for that was the fashion of the times; but the book had virtue in that its author recognised the significance of human activities in New Zealand. In short, Marshall laid the foundation of geography in this country. So well did he write, and so efficiently did he work, that his influence persisted for more than a generation, and will linger. Geographers in New Zealand, no matter what their particular 'philosophy' may be, will remain forever indebted to him.

Professor Patrick Marshall, M.A., D.Sc., F.R.S.N.Z. lived a full life. The scientific world of New Zealand is the emptier for his passing.

It was with great regret, too, that members of the society learned of the death on 11 July, 1961 of Mr Albert F. Ellis. Of New Zealand's sons who have achieved fame, none perhaps deserves greater recognition for the contribution he made to the country's welfare, for it was Mr Albert who guided development of the phosphate deposits on Inangahua and Otago Island, and but for his wisdom, energy, and breadth of vision New Zealand would never have achieved her prominence as a primary producer. Those same qualities for Albert applied to his personal interests, to the study of many institutions, among them the New Zealand Geographical Society, of the four years preceding his death. Mr Albert Ellis was a Vice-President of the Auckland Branch, and his death leaves a gap which cannot readily be filled.

IN OUR CONTEMPORARIES

1. *In New Zealand Journals* . . .

THE CHANGING FACE OF CANTERBURY

FARMING IN CANTERBURY: P. R. Stephens, *N.Z. Journal of Agriculture*
Vol. 81, No. 5, November 1950, pp. 405-420; *ibid.*, Vol. 81, No. 6, December
1950, pp. 503-517; *ibid.*, Vol. 82, No. 1, January 1951, pp. 15-26; *ibid.*, Vol. 82,
No. 2, February 1951, pp. 109-117.

This series of four articles sketches the development of farming in the Canterbury Land District. The century of development is divided into four periods, 1850 to 1880, 1880 to 1900, 1900 to 1920, and 1920 to the present day. Each period is treated in a separate article, though the chronological order is not rigid.

The first, opening with a brief sketch of New Zealand in 1850, deals with the initial settlement and early mixed farming; then proceeds to the Australian squatter invasion, describing problems such as land tenure, scab, and transport difficulties; and finally describes the progress made until the depression of the 1880's. Maps, diagrams and photographs are used to good advantage to show the surface character, climate and natural vegetation cover of Canterbury at this period.

The second article describes population trends as the farming community grew, the development of transport, and the rise of arable farming. In some years wheat now occupied more than 4000 acres on bonanza wheat farms such as Cameron's Springfield estate and the Studholme's Te Waimate property. Expanded wheat production was possible only with the greater use of machinery, particularly the reaper and binder and the steam-driven threshing machine. The first freezing works were built at Belfast and by 1886 Canterbury took the lead as an exporter of frozen lamb and mutton. The meat trade stimulated progress in supplementary feeding and crop rotation.

The third contribution deals with land reform, an outcome of mounting dissatisfaction against land monopoly. In 1890, out of a total of 3,762,000 acres freeholded, 1,718,000 acres were held in 120 estates of 5000 acres or more. A description of land subdivision in Canterbury following the election of the Liberal Government is given local colour by reference to specific estates and by an accompanying map showing land acquired for settlement by the Crown up to 1915. The period 1900 to 1914 was one of stability 'unruffled and tranquil in every way' though bonanza wheat farmers gradually changed over to mixed farming. The growing scarcity of land in Canterbury resulted in the migration of men to the North Island where they made use of farming experience gained in Canterbury, but not always with success.

The final article 'brings the story of Canterbury farms up to the present day', briefly sketching such influences as war, soldier settlement and depression, and discussing more fully trends in farm management, progress in crops and pasture research, and advances in the mechanisation of farm work.

This article is primarily an historical account of events and changes affecting farming in Canterbury. The student of geography may be somewhat disappointed

to find that little reference is made to the character of the rural landscape at successive periods. A descriptive account of the present-day Canterbury farming scene, with its regional variations, illustrated by a map, might have been a more satisfying conclusion to an interesting and exhaustive compilation of the developments which have produced such a landscape, than the scanty reference to minor farming industries and the brief assessment of current changes which do in fact constitute the final paragraphs.—JUNE CHAPMAN

2. *In Overseas Journals* . . .

SCIENTIFIC INVESTIGATIONS IN FIORDLAND

OPERATION FIORDLAND: A NEW ZEALAND EXPEDITION: *Canadian Geographical Journal*, Vol. 41, No. 4, October 1950, pp. 152-165; *ibid.*, Vol. 41, No. 5, November 1950, pp. 210-225.

This is a pictorial review of the work of the New Zealand-American Fiordland Expedition of 1949, in which representatives of several government departments and local research institutions were associated with Colonel J. K. Howard and Dr. O. J. Murie of the U.S.A. The desire of the American participants to study the effects of a new environment on the wapiti, an animal which they knew intimately, combined with the recognised need in New Zealand for field investigation to learn more of the habits and ecology of introduced mammals in general, provided the required incentive and central objective. As the establishment and maintenance over a period of four months of a field unit in such isolated country as the area between Caswell and George Sounds was a costly undertaking, it was decided to use the facilities for a topographical and general biological survey at the same time. Between January and May about twenty scientists and four surveyors, with packers, hunters and camp staff, carried out a wide range of work.

Some disappointment at the lack of spectacular results was expressed at the time through the columns of some newspapers, a product of the popular idea that every explorer should in some way emulate Columbus. Although the criticism was not entirely justified, it probably would have been good policy for the expedition to have had someone responsible for summarising the work for early publication. Credit must, however, be given to Mr. A. L. Poole, deputy scientific leader, who contributed informative articles on the expedition to the *New Zealand Science Review* of August 1949, and to the November 1949 issue of the now defunct journal *Education*. A comprehensive bulletin of combined reports was also compiled but has not yet been printed.

In these two contributions a series of fifty-six striking official photographs supplied by the Government of New Zealand through the High Commissioner for New Zealand in Canada has been attractively arranged and well produced. To this picture story has been added a brief factual summary, anonymous, as is usual with official 'handouts', but in this case evidently carefully checked and accurate as far as it goes. We may well congratulate our Canadian contemporary on its enterprise, while regretting that local resources were not used more expeditiously to produce some comparable presentation in a New Zealand journal.—R. A. FALLA

REVIEWS

A FRENCH ACCOUNT OF EARLY NEW ZEALAND

NEW ZEALAND 1826-1827. From the French of Dumont d'Urville. An English translation of the *VOYAGE DE L'ASTROLABE*, with an introductory essay by Olive Wright. Wellington: The Wingfield Press, 1950, pp. 251.

Before the publication of this book there was little to remind New Zealanders of Dumont d'Urville save a few place names and some fragmentary English translations from his journals. For the biographical essay on d'Urville and for the scholarly translation of his own account of his experiences in New Zealand and around part of the New Zealand coast we owe Miss Wright a debt of gratitude. The translation which forms the second and larger part of the book is a delight to read.

But Miss Wright has given us more than that. She has awakened the interest of scientist and layman alike in the journals, albums of plates and atlas which record the results of the 1826-1829 voyage of the *Astrolabe* round the world. Of the five volumes of narrative, the second and third volumes are devoted entirely to New Zealand. It is from the first of these that the translation for *New Zealand 1826-1827* is taken. Of over fifty maps and plans in the atlas, no less than thirteen are maps of the New Zealand coastline, including five more detailed plans of harbours and bays. Add to this record the beautiful copperplate engravings, many hand-coloured, illustrating not only the narrative but also the volumes on botany, zoology and entomology, and one can begin to appreciate the wealth of information from which the author derived her material and her inspiration.

To d'Urville, the navigator, the specific purpose of the voyage was to 'complete the geographic study of the coasts still imperfectly charted and of some scarcely known groups of islands' in the Pacific. To d'Urville, the scientist, the broader purpose was to add to the sum of knowledge of the earth itself. To this end he was aware of the need for understanding the total environment of those parts of primitive New Zealand which he and his fellow scientists observed, recorded and described. For the geographer, such descriptions of the natural landscape are invaluable. So too is the record of his study of Maori settlements, language and customs.

After a stormy passage across the Tasman, d'Urville sighted the New Zealand coast to the south of Cape Foulwind on the tenth of January 1827. Then he sailed north and by the sixteenth was in Tasman Bay which became a base for six days. Thence the route was through the French Pass, where the corvette narrowly escaped destruction, into Admiralty Bay and Cook Strait. Contrary winds prevented the navigator from entering Wellington Harbour so the course was set for Palliser Bay, which proved equally unapproachable. D'Urville stated his 'intention to investigate the whole of the east coast of Ika-Na-Mawi [North Island], if time permits, and not to stop before reaching North Cape'. In fact his journey took him to Whangarei then back to the Hauraki Gulf where some days were spent charting the coast and exploring the countryside. Of special interest is the report in M. Lottin's diary of the expedition across the narrow isthmus of land which separates the Manukau and Waitemata Harbours. On the first of March the *Astrolabe* made her way to North Cape then back to the Bay of Islands where d'Urville recorded the changes which

had taken place since his first visit in 1824. The week spent in the Bay of Islands before setting sail from New Zealand on the eighteenth of March 1827 was all too short for the investigation of the area and the study of native settlements and of the natives themselves.

Following the narrative and adding to it are extracts from the diaries of officers of the *Astrolabe*. The 'Letter of Instructions' to d'Urville from the Admiralty, three useful appendices, a chronological table, a bibliography and an index add to the usefulness of the book.

New Zealand 1826-1827 is beautifully produced. Twelve of the fourteen illustrations are reproductions from the albums of the original edition of *Le Voyage de l'Astrolabe*. A criticism which may be levelled is the lack of an adequate map bound with the volume. D'Urville's 'Map of New Zealand 1835' and the part of his chart of the Hauraki Gulf have been reduced so much in scale as to be almost worthless.

Nevertheless the general reader and student alike will welcome this most absorbing and useful book.—JOYCE K. BEWLEY

INVESTIGATIONS INTO WILD-LIFE PROBLEMS

INTRODUCED MAMMALS OF NEW ZEALAND. By K. A. Wodzicki. Wellington: Department of Scientific and Industrial Research, 1950, pp. 249.

In this book, which is published as D.S.I.R. *Bulletin No. 98*, Dr. Wodzicki has gathered together, carefully and laboriously, a veritable treasure trove of statistical material gleaned with infinite patience from the earlier literature, from yearbooks and departmental reports, and by means of a voluminous correspondence with trappers, hunters, foresters, naturalists and others from one end of the dominion to the other. In essence the book is to be regarded as G. M. Thomson's classic, *Naturalisation of Plants and Animals in New Zealand*, brought factually up-to-date and revised, with respect to idiom, in accordance with the newer 'Eltonian' concepts in animal ecology. A compilation of this sort was an essential prerequisite to any substantial advance in the study of the many outstanding wild-life problems in New Zealand today. It was fortunate that someone of Dr. Wodzicki's calibre was at hand to undertake the task.

But the book cannot escape criticism. Dr. Wodzicki has gathered all the information together but no one can yet say, precisely, how accurate much of that information is. In particular, information collected by means of questionnaires is to be distrusted. Not all of those replying are of equal competence as observers; not all can be expected to interpret questions, no matter how skilfully framed, in the same light; not all are equally unbiased. To a trapper from Reefton the forests of the Longwood Range in Southland might appear almost empty of opossums, but to the man from Canterbury the same forests would appear to be overrun by the animals. And if there be any cause to distrust the sources of information then the tables, graphs or distribution maps based on such information are equally suspect.

This element of suspicion becomes, to the reviewer, most marked in reading the disappointingly brief and scanty sections of the book describing the effects of the various introduced mammals on the vegetation. The poverty of these sections is apparently due to the fact that Dr. Wodzicki himself is primarily a zoologist, not a

botanist; and he has therefore found it necessary to rely on the second-hand observations of others, accepting their statements at face value. This is, of course, not so much a criticism of Dr. Wodzicki as it is a criticism of others, including the reviewer, for not publishing the results of more detailed studies. The animal-plant relationship problem is the crux of the whole wild-life problem and was surely worthy of more critical examination and greater emphasis. To cite but one example—the short section on page 223 dealing with the effects of wapiti on the plant life and on the forests is so vague and so inaccurate that it might have been better to have simply stated that nothing at all was known. The evaluation of the interrelationships of plants and animals is an extraordinarily complex matter demanding a long apprenticeship. Casual observations by untrained observers are seldom of any real value.

A few minor items might be mentioned. Dr. Wodzicki remarks, 'It is doubtful whether chamois, except during particularly heavy snowfalls, would penetrate very deeply into the belt of scrub and "non-commercial" forest which extends from an altitude of 3000 feet to about 4500 feet' (p. 171). But seven out of ten of all chamois seen by the reviewer in the ranges away from the main divide in Canterbury have been seen below the timber line, with one mob of six animals observed feeding in summer along the lower forest margin in the Cass River valley at an altitude of little more than 2000 feet. Again, in connection with wild pigs, attention might be drawn to the distribution map, Figure 50. One of the heaviest concentrations of these animals known to the reviewer is in the area lying between lakes Hakapoua, Poteriteri, and Foveaux Strait, a concentration not indicated on the map. Red deer are also present in great numbers in this heavily forested country but deer infestation is recorded in Figure 40 as light although it is shown as heavy in the mountain country a little to the north. The reviewer would suggest that some, at least, of these errors or omissions arise through too great a reliance on reports by hunters, official or unofficial, and such reports, in the normal course of events, come to hand only from those types of country favoured as stalking grounds. The distribution maps in such cases, therefore, reflect hunters' preferences in respect to terrain as much as they do animal preferences.

But enough has been said to show that the basic data are not altogether reliable. The maps themselves are generally poor. It is in this matter of map production that geographers in New Zealand could be of most immediate assistance to the naturalists and ecologists. Dr. Wodzicki's maps masquerade as dot maps but the symbols have no fixed mathematical value and the maps are really little more than generalised distribution diagrams.

These faults notwithstanding, Dr. Wodzicki's book must remain essential reading for everyone with an interest in New Zealand wild-life problems—and every intelligent citizen should have that interest, for these problems concern everyone vitally. The book will remain a standard text until new and improved editions appear. The criticisms contained herein are only entered upon in the hope that they will serve to lead, in some small way, to such improvement. The book itself, by present day standards, is absurdly cheap. The printers, and particularly the proofreaders, are to be congratulated on the clarity and readability of the text and on its freedom from errors. The imagination displayed by a government department in permitting publication of a bulletin in this form is to be highly commended.

In conclusion might it be said that the reviewer is in wholehearted agreement with the author when he concludes virtually every chapter with words to the effect that further research into these problems is needed. An immense amount of additional research is needed but Dr. Wodzicki has well and truly laid one of the foundation stones.—J. T. HOLLOWAY

EXCURSION INTO FIORDLAND

FARTHEST WEST: AFOOT AND AFLOAT. By A. H. Reed and A. W. Reed. Wellington: A. H. and A. W. Reed, 1950, pp. 192.

In a country of such remarkable contrasts as New Zealand it is surprising that so little has been written in popular form on the more remote corners of our land. Among the few writers who have presented such descriptive accounts none has done so more ably than Mr. A. H. Reed, and those who have read his *Farthest North* and *Farthest East* will welcome this recent addition. *Farthest West* is a joint effort by uncle and nephew, resulting from their expedition into one of New Zealand's most inaccessible parts, Southern Fiordland. Written in diary form, the book gives a graphic day-to-day picture of the pleasures and perils of tramping through an inhospitable countryside.

In the first part Mr. A. H. Reed, aged seventy-four, describes in his intensely personal and frank manner, the eight days' tramp from West Arm, Lake Manapouri to Supper Cove in Dusky Sound. The route led up the Spey River, across Murrell Pass and down the Seaforth River to Dusky Sound, a route previously traversed by only a few dozen Europeans. No track was available to guide the two adventurers; only a map based on Wilmot's topographic survey of 1897, the verbal instructions of friends, and their own good sense prevented them going astray. This is not a geographical description but a personal account written in a pleasing style by an observer with an eye for detail. The reader is thus provided with a vivid picture of a little-known region. The intermittent heavy rains, the almost impenetrable forest, the rugged grandeur of the glaciated landforms, the turbulent boulder-strewn streams, and the vicious attacks of sandflies by day and mosquitoes by night, combine to set the scene wherein the two not-so-young men succeeded in satisfying their adventurous spirits.

In the second part Mr. A. W. Reed gives an account of the subsequent part of the expedition, the more comfortable occupation of viewing the fiords from the deck of the *Alert*, a vessel well known to visitors to Milford Sound. The return trip of five days led from Dusky Sound to Milford Sound, with brief calls at the intervening fiords and coves. From Milford the authors made their way by more conventional means back to Lake Manapouri, thus completing in a fortnight a remarkable and comprehensive journey through Fiordland.

The subtitle *Afoot and Afloat* indicates the twofold nature of the trip but gives no hint of a third part to the book and of the five appendices which together provide a most interesting and valuable compilation of historical data on the area traversed. The third part consists of the first publication of Wilmot's *Journal*, a day-to-day account of his survey expedition in the Manapouri-Dusky Sound region during 1897. The appendices provide informative material on the discovery and exploration of the Dusky Track.

Farthest West is well illustrated with many fine photographs and there are several sketch maps, some of which have lost clarity on reproduction. The keynote of the book is, however, the blend of personal adventure and historical background written in a clear unpretentious style. This book should find a wide appeal among New Zealanders.—OWEN BROWN

PLANTS AND MEN

BOTANICAL EXPLORERS OF NEW ZEALAND. By Rewa Glenn. Wellington: A. H. and A. W. Reed, 1950, pp. 171.

This little book serves as an admirable introduction to the history of New Zealand botany. Looking through the chapter headings one sees the names of Solander, Banks, Menzies, Bidwill, Raoul, Colenso, Sinclair, Lyall, Haast, Kirk and others, all of whom are commemorated by their names being given to genera or species of native flora: the genera *Haastia*, *Raoulia*, the species *Nothofagus Menziesii*, *Astelia Solandri*, *Senecio Kirkii*.

Some of the names about whom Miss Glenn writes are familiar to most, if not all, but there will be others, about whom some may know little or nothing. Miss Glenn now gives just that information, and withal gives it in a very charming manner. It is evident too that she has gone to no little trouble to make certain that her facts are correct. It is in fact the kind of book that is not only very readable but teaches also at the same time.

May one express the hope that when a second edition is called for, as one hopes it will be, Miss Glen will include a chapter on Robert Laing of Christchurch, who did more for the discovering and naming of New Zealand seaweeds than anyone else, and whose name, like those mentioned above, is perpetuated in genera and species of seaweeds.—V. J. CHAPMAN

A THIRD OF THE WORLD'S AREA

GEOGRAPHY OF THE PACIFIC. Edited by Otis W. Freeman. New York: John Wiley and Sons, 1951, pp. 573.

The geography of the Pacific Ocean territories has long awaited adequate and competent presentation, but such is not to be found in the symposium contained in this book. The three brief introductory chapters comprise nothing new in the way of material or viewpoint; the last one on trade and transport in the Pacific must also be classed as pedestrian. Fifteen chapters intervene, and are devoted to the different areas.

Unfortunately treatment varies from chapter to chapter and from author to author—a characteristic of all symposia and one not confined to this book. Some island groups are accorded adequate attention; others are not. Fiji is described in four and a half pages, Hawaii is given forty—but he is a brave man who suggests that this coverage represents proportionately the geographic significance of these islands. Furthermore some contributors become overwhelmed in a mass of detail; others, more successful, generalise for their territories as a whole and thereby make a contribution of value and originality.

The problem of space undoubtedly contributes to this unevenness. But why well over one hundred pages should be devoted to the geography of Australia and

New Zealand and nothing at all to their Pacific interests and responsibilities is difficult to understand. The preface suggests that other continental margins of the Pacific have been adequately treated elsewhere. If this explains why Australia and New Zealand *are* included, it must be urged that they, too, have been more adequately treated elsewhere than in *Geography of the Pacific*. The hundred pages could more profitably have been awarded to those authors who have an intimate knowledge of their insular territories, but who were cramped for space, despite their ability to discuss their problems without pages and pages of statistical tables.

The book has defects other than those of organisation, and in this respect New Zealand readers can make a ready assessment in terms of their own country. And they will be most disappointed. On page 424 is reproduced a map which would not be acceptable in even a fifth-former's essay. On it nine place names are misspelled, 'straight' appears unashamedly for 'strait', and towns are not properly located. All other maps must therefore become suspect. Statistics used are often out of date. In the case of New Zealand, population figures for 1939 are given, although a census was taken in 1945 and estimates for 1949 are available in the *N.Z. Official Year-Book, 1947-1949*. In other words, simple, reliable and up-to-date facts do not feature as they should.

In its treatment also of the broader geographic aspects of Pacific island problems the book disappoints even the most general of readers. Trusteeship and its accompanying responsibilities, the future of underdeveloped territories, the wellbeing of dependent peoples, changing dietary and social habits, the implications of Pacific strategy in terms of these islands and these peoples—such questions are neither posed nor answered.

But there are compensations. The authors of the chapters on the Philippines, Indonesia, and the Kuril and Ryukyu Islands lift their work above the commonplace and a mere recital of facts, for they at least appear to have understood something of the personality of the areas with which they deal and to have appreciated that problems do exist. Yet to geographers and others who reside outside the dollar area, the equivalent of ten dollars will be far too much to pay for a book that fails to fulfil its prefatorial claim of 'a comprehensive book dealing with the Pacific geography'.

FRANCE THROUGH ENGLISH EYES

FRANCE. By H. Ormsby. London: Methuen and Co. Ltd., 1950 (Second edition), pp. 525.

This new edition of Dr. Ormsby's work, still the only full-scale treatment of France by a British geographer, is to be warmly welcomed, especially as it has been needed for some years. Although some revision has been undertaken, and a summary by Mr. F. J. Monkhouse of economic conditions (1939-1947) added, the plan of the book remains unchanged, as does nearly all the text, a closely-woven fabric of descriptive detail for which all students of geography are indebted.

Though not an inspired account, in the sense of the French masters, the handling of the regional studies in particular not only wisely avoids an attempt to imitate the French tradition but is specifically Dr. Ormsby's own and is scrupulously objective. One feels however that a greater effort to distinguish salient features from the mass

of detail in order to picture more definitely the distinctive character of the various regions would have produced a more illuminating and more satisfying interpretation. As a preparation for these studies, moreover, something more seems to be required than the present introductory chapter with its competent though regionally unrelated account of the climate. The other problem arising from the plan of the book is that of the relationship between the regional chapters and the part devoted to the systematic economic geography. Detailed treatment in the latter case results inevitably in a division of material in order to avoid repetition, and this sometimes leads to inconsistency. An example is found in the three references to the ironfield of the Norman *bocage* (pp. 96, 152 and 444) which convey three separate and not easily reconcilable impressions.

Unfortunately one of the merits of the new edition, namely its moderate price, only four shillings more than when the book was first published in 1931, provides the reason, perhaps, for justifiable disappointment. In other words the revision is all too inadequate. Some of the numerous small errors and misprints in the earlier edition have been corrected, though too many remain. To say the least they are misleading. Thus at the foot of page 396, Gironde is meant, and in any case there is no *département* of Garonne; on page 93 the tributaries of the Vilaine intended are the Ille and Meu; it is unfortunate to read on page 195 that coal occurs in unworkable conditions in the Boulonnais when in fact the colliery at Marquise can be seen by any observant traveller on the Paris express from Calais. Spelling errors are frequent, such as Mené for Menez, Sèvres for Sèvre (river) and Bâlon for Ballon.

The frequent references to events of the first World War, especially to the part played by terrain in the bitter and exhausting battles of the western front, although skilfully traced, read somewhat strangely at a time when even the aftermath of a second war has passed. This is further emphasised by neglecting to extend the bibliographic lists, so that few references to literature published later than 1930 are given.

It is in the section on the economic aspects that the revision leaves most to be desired. Substantial developments in the past twenty years, including achievements of which the French are justifiably proud, find little or no place. Yet while much of the old France, the France of the peasant, lives on, there is a new France of progressive outlook stimulated by modern techniques and a new-found efficiency. Thus the important point that since 1948 electricity production from water power has exceeded that from coal is overlooked, and reference to some of the larger installations, even those built several years ago, is sketchy. Again there is no mention of the great road, the highest in Europe and cut in 1936 through the Col d'Iseran, which has considerably altered the relation between upper Grésivaudan, Briançon and the Italian frontier passes. Finally, not enough emphasis is given to industrial expansion in the Midi, which has affected in a striking manner the growth of towns.

It is satisfactory to find that the hundred or so maps and diagrams have been included in the new edition, yet it is a pity that those showing agricultural distributions, now constructed on a sounder cartographic basis, are drawn far less neatly than the original series. Despite the lack of thoroughness in revision, Dr. Ormsby's book remains not only a standard work but a testimony to the author's courage and determination in writing it. Apart from the superficial blemishes it is a product of

much scholarship and brings to the reader unerringly, if not always vividly, the varying changes in the French scene. For advanced students it enters another lease of life as an indispensable textbook.—K. C. EDWARDS

IRRIGATION SCHEMES ON THE MURRAY RIVER

WATER INTO GOLD. By Ernestine Hill. Melbourne: Robertson and Mullens, 1949, pp. 332.

A perusal of this book should convert the few remaining environmentalists to a modern outlook on geography. Here is the answer to any who think that flat land, sunshine and water are the only reasons why man produces fruit and makes the areas some of the most prosperous of the commonwealth. The whole book is an answer to the question on the geography of the irrigated areas. Why are the various types of irrigation farming carried on? It pays. The book tells the tale over the years, of heartbreak, disillusionment and failure; of people who walked off and went back to the established areas of Australia; of others who came to take their places and in turn to sink their money in irrigated farming. The causes of the walking-off were many but there was only one reason. The people were penniless.

So the story develops until after the long years of hope and disillusionment, of trial and error, the problems were solved, and prosperity shyly appeared, to remain and make the areas some of the most desirable and prosperous in Australia, with a demand for land unsatisfied until the Snowy River is diverted into the Murray.

There were but a few isolated communities along the banks of the Murray in the late 'eighties and early 'nineties of the last century. The inhabitants were hundreds of miles from markets; their only means of transport for extremely perishable goods was by paddle steamer on an unreliable river. They were growing fruit in a fairly suitable climate on flat land, probably well above the high-water level of the river, so that simple gravity irrigation was in most cases out of the question. Here were some of the problems to be solved and the lessons to be learned by bitter experience during the next half-century.

Few realised that irrigation farming required techniques all its own. The fruit rotted by the ton until the necessity for railways across the apparently useless mallee country from Melbourne could be proved; this turned the thoughts of the growers to the drying of fruit; none knew the right techniques. The Murray had to be mastered to provide a regular supply of water; there were no pumps in existence to supply the volume of water; these had to be made. The work of the Chaffey brothers, Deakin and a host of others must be given an honoured place. Politics entered into it. The riddle of the currant grape had to be solved, and cultivation of the commercial fig learnt. There was the racket over the stone fruit stocks. The problem of the freed salt of the ancient sea bed caused endless worry. There was the national financial crisis when prosperity seemed within grasp. Marketing difficulties arose; there was the competition of California and the Mediterranean coast-lands. There are still unseasonable frosts in spring and thunderstorms in January and February and pests to be controlled. These are some of the facets discussed in the book. No teacher after reading it will again talk glibly of 'geographic factors'.

The book itself is low-priced and interesting enough to be placed in a post-primary

school library. The style in many cases tends to journalese and fine writing but these are negligible blemishes if one reads the book for interest and content. Many of the fifty-six photographs enhance its value as a book that both young and older students of geography should read.—A. HALEY

PHOTOGENIC SOUTH ISLAND

THE MOUNTAINS, THE BUSH AND THE SEA. By John Pascoe. Christchurch: Whitcombe and Tombs Ltd., 1950, pp. xvi + 96 pages of plates.

The advent of a photographic report of some of New Zealand's backcountry by such a mountaineer and photographer as Mr. Pascoe has been welcomed with enthusiasm by lovers of the New Zealand landscape.

In his introduction Mr. Pascoe goes to elaborate length to explain that he is not an 'artistic' photographer but merely a traveller who reports with his camera; yet on opening the cover and seeing the very fine frontispiece, one is inclined to feel that Mr. Pascoe is too modest. However, subsequent photographs in the book tend to suggest that Mr. Pascoe has a true opinion of his own artistic ability. Quite apart from the standard of reproduction of the photographs (which is quite good) the prints have a very unsatisfying 'overallness' with the 'contrast' often very badly handled. No doubt much of the writer's difficulty in this respect can be traced to his unwillingness to process his own photographs. A monstrosity such as his photograph of Mt. Cook entitled 'Mass' could never have happened if he had put a little of his deep feeling for the mountains into watching his developing dishes.

Mr. Pascoe has sought to use the popular technique of placing photographs with contrasting titles on adjacent pages. This has been done very effectively in the two pictures 'Gold Prospector' and 'Prospector's Wife' but for the most part the pairs are spoiled by having one very weak member. For example 'She Obeys' is a very poor picture of a sheep set opposite 'His Bark', which is a well conceived shot of a sheep dog. Again 'Gold Prospector's Hut' is a very competent picture of a slab hut, but is set opposite a very dowdy picture of a tent entitled 'Moraine Camp'. It is difficult to see what moved Mr. Pascoe to include seascapes in his book as he has obviously had very little experience with this branch of photography, and his picture of a large and shiny rock supporting a diminutive bather and entitled 'Open Sea' has surely the wrong label. His final picture, 'Farewell' is a fine example of how to break most of the canons of good composition without achieving any advantage.

There are, however, some very good photographs in this book. 'Fisherman' is a splendid shot of a man rowing a dinghy taken from an unusual angle; 'December Afternoon', a picture of a climber resting at a high bush-camp has captured the spirit of New Zealand mountaineering absolutely; 'Maze of Distant Ridges' printed on the dust cover, is a really beautiful picture. These alone make the book well worth while. Finally, Mr. Pascoe's photographic report could be excused all its bad pictures if they were necessary to complete a story, but the reader will look in vain for any connecting theme. He is forced to evaluate Mr. Pascoe's book as a work of photographic art, which, as Mr. Pascoe admits, it is not.—A. L. ODELL

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THE NEW ZEALAND GEOGRAPHICAL SOCIETY

THE NEW ZEALAND GEOGRAPHICAL SOCIETY was founded officially in Wellington towards the end of 1944. Its real foundation, however, took place in Christchurch in 1939 when a group of enthusiasts formed what is now the Canterbury Branch of the Society. Their lead was followed in February 1944 in Wellington, and further branches came into being in Auckland and Dunedin early in 1945.

The aims of the Society as stated in the constitution are 'to promote and stimulate the study of geography'. These are the aims of more than one society in the world, and the New Zealand Geographical Society is particularly concerned with geography in New Zealand. It is therefore the Society's policy to stimulate geographical studies about New Zealand and matters closely related to the Dominion.

The Society undertakes the publication of a journal which at present appears twice a year. Branches of the Society organise lectures, study groups, and excursions, and encourage their members to prepare matter for publication in the Society's journal, the *New Zealand Geographer*. Contributions from overseas writers and those who are not members of the Society are also encouraged.

The Society also publishes half-yearly the New Zealand Geographical Society's Record of Proceedings of the Society and its branches, known as the *Record*. This, in addition to summaries of addresses given to branches, contains book reviews, film reviews, and contributions of a lighter nature than those appearing in the *New Zealand Geographer*.

Selected articles from the *New Zealand Geographer* are reprinted and issued separately in the *Reprint Series*. Those that have so far been made available in this form are *Weather Forecasting in New Zealand*, by Ian E. M. Watts, reprinted from *New Zealand Geographer*, Vol. I, No. 2, October, 1945; *Literature and Landscape in New Zealand*, by Alan Mulgan, reprinted from Vol. II, No. 1, April, 1946; *Manufacturing in New Zealand: Its Outstanding Characteristics*, by J. L. Hewland, reprinted from Vol. II, No. 1, April, 1946; *Land Utilisation in Metropolitan Christchurch*, by F. Parks, reprinted from Vol. II, No. 2, October, 1946; and *The Importance of the Land: The Future of New Zealand Agriculture*, by Kenneth B. Cumberland, reprinted from Vol. III, No. 2, October, 1947.

The Council in 1947 decided to proceed with the publication in book form of a series of *New Zealand Geographical Society Special Publications*. Moneys have been set aside for this purpose, and as material of high quality and real value becomes available it will be published. The first number in this series, *New Zealand Weather and Climate*, edited by B. J. Garnier, Miscellaneous Series No. 1 was published in 1950.

Membership of the Society is open to all persons interested in the aims of the Society. Full details of membership will be sent on request by the Secretary, New Zealand Geographical Society, Department of Geography, Canterbury University College, Christchurch, C.I., New Zealand.

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